

THE AUSTRALIAN EEB

30c. PER COPY.

For Subscriptions, etc.,
see back page.

P.O. BOX 177
SANDY BAY,
TASMANIA 7005
AUSTRALIA

→ Commonse Electronics



AN INFORMAL ELECTRONICS
EXPERIMENTERS BULLETIN

AUGTOBER 1972

Vol. 8, Nos. 4+5

P. 69

Just published

**New (fourth) edition of the
ever-popular**

AMATEUR RADIO TECHNIQUES

by PAT HAWKER, G3VA

Aimed at extending the reader's awareness of new devices and techniques. Provides a source book for many useful circuits and aeriels.

An *ideas* book rather than a constructional manual, but an ideas book that will prove its value time and time again.

Substantially enlarged edition comprising **256 pages** with over **600 diagrams**. New material and features include more emphasis on integrated circuits, a quick guide to digital electronics, and much additional information on the cure of tv interference and on aeriels.

£1.80 including postage and packing

**amateur
radio
techniques**

Fourth Edition

P 69: This magnificent book was reviewed in Feb. 1971 EEB. It hasn't been re-organised as we'd like, but it would be a gem in any electronics experimenters library (Amateur or other). We recommend it most wholeheartedly.

Order from WIA, NZART, or likely quicker from RSGB, 35 Doughty Street, London W.C. 1, England, U.K. Europe! \$3.75 = £1.80; or send £ bank draft.

70: Counting with Electronics, II.

71: W. H. K. Industries: Welcome!

72: Automotive Topics (Letters).

73: The Reciprocating Detector, II.

76: A New Look at Old I.F. Stages.

78: Is Direct Conversion Worthwhile??

81: Parts Availability and Politics, II

83: Editorial, and maybe some Letters

84: EEB Adverts; we're not making money (maybe thats why our adverts are so popular?), but we're having fun.

86: Where the DX is At!

87: Modulated Light Communication ...

96: 1972 ARRL Handbook Revisited. Fb.

98: Hidden Antennas Squaretable.

99: Gneral-coverage Receiver Design (L)

100: Artistic Experimenter (L)
+ ESSENTIAL INFORMATION FOR YOU.

RADIO COMMUNICATION August 1972

MISCELLANY:

71: Hart-to-spel werds.

75: → vive La France.

77: The Human Side of TVI.

80,82: Quotes, Recipies (The Mail Service may be headed for extinction, but PMG Profits certainly aren't! It will make the next postal rise that much more galling for EEB...)

97: What Not to Do..? ☆ ☆ ☆ ☆ NEXT MONTH (December, of course): Exhaust-gas Analysis, Pulse Width Generator, more Reciprocating Detector, a new look at FETs, Smoke-Ring Generator.

COUNTING WITH ELECTRONICS, Part II

-- by R. Fam and R. S. Maddever (VK3)

In the April EEB we described a simple single counting stage which could be coupled to others to form a binary counting unit. It may be mentioned, in reference to last month's Editorials, that we are well familiar with the use of Integrated Circuits, but simple discrete units of the type described here are quite valuable to illustrate circuit functions.

One of the disadvantages of a simple row of "flip-flops" for counting, is that as the inputs are switched from one side of the preceeding stage to the other (from ADD to SUBTRACT) extra unwanted pulses are formed by the switching. And if many stages are used a suitable switch becomes expensive.

A worthwhile addition to the counting board is, therefore, an electronic "switch" (or "gate") allowing the output from either the ADD or SUBTRACT side of the flip flop to be sent on to the following stage. In fig. 1 the switch consists of the two transistors, Q4 and Q5. They have a common collector load of 1K Ω . Whichever transistor is not wanted to send a pulse out has its base connected to a line which is made +1.5 volts and is therefore cut off. The other transistor has its base connected to a line left floating or merely earthed. The bases are connected via diodes so that one stage does not influence the other.

In fig. 1 the resistors, capacitors, and diodes are not at all critical in value. The transistors may be almost any types. Germanium and silicon types have worked quite well even when diodes were all germanium, but note that Q3 should be able to drive a 6V 40mA globe so needs to be a medium power type. The others must be of the same type (whichever is chosen). PNP polarities are shown. If NPN ones are used, reverse the battery connections and ALL DIODE polarities as well. Computer board types suitable are 033 or 034 for PNP, 083 or 084 for NPN; 015 or 018 PNP or 065 NPN (planar HF types) could be used for all except Q3.

Fig. 2 shows a printed circuit board suitable for plugging into an edge socket. It is viewed from the copper side, and components are drawn here with finer lines; the components are on the other side, and you are seeing them with "X-ray eyes".

Fig. 3 (p. 71) shows some of the boards connected together, and fed by a circuit suitable to make good pulses from a telephone dial. With-

out this amplifier-trigger system, the contact bounce from the telephone dial contacts would create spurious pulses, as shown by the waveform to the left of the dial in fig. 3.

The next article in this series (in December or February next) will describe "A Crystal-controlled Variable Pulse-width Generator", and will contain enough Integrated Circuits quite to satisfy the fastidious.

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

< The beginnings of all things are small >
-- Cicero.

~~~~~

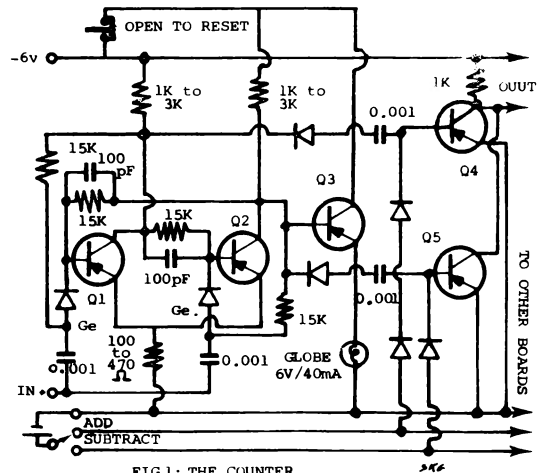


FIG. 1: THE COUNTER

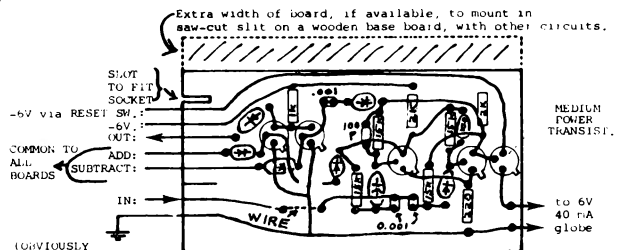
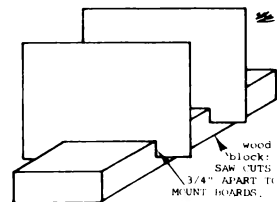


FIG. 2: The board from the copper side (figures are on the other side -- as seen with "X-Ray Eyes").

Quite some time ago, Henry Pinot of the United Press compiled a list of words which he had observed were the most frequently misspelled words appearing in press dispatches which passed over his desk. While these are not words that would ordinarily appear in amateur publications it might be interesting to list them here:

|                |               |
|----------------|---------------|
| uncontrollable | paraphernalia |
| changeable     | likable       |
| guage          | judgment      |
| naphtha        | dietician     |
| occurred       | embarrass     |
| discernible    | indispensable |
| diphtheria     | harass        |
| permissible    | rococo        |

Only one of these words duplicates this editor's favourite list which was taken from a newspaper over 30 years ago. You are guaranteed that the average person cannot get more than three of these right, and if you don't believe it, try them on your friends:

|              |              |
|--------------|--------------|
| tranquillity | sacrilegious |
| naphtha      | supersede    |
| kimono       | rarefy       |
| paraffin     | battalion    |
| liquefy      | ukulele      |

One more that can be added from personal observation is the simple "Davy Jones's Locker" which very few people can spell, because it defies usual laws of possessives, and because of this is defined separately in the dictionaries. Try this one too on your friends.

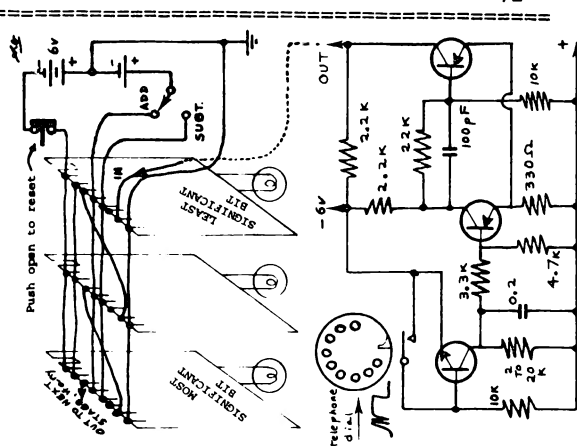


FIG. 3: Pulse Amplifier with fairly long time constant, followed by Schmitt Trigger...

### ELECTRONIC DESK CALCULATOR

**Featuring:** 14 digit LED's

**Functions:** Addition, Subtraction, Multiplication, Division, Squaring, Square Root, One constant data memory, One independent data memory, Etc.

External printing and programming modules are under development, which can be added to the pre-wired interfacing feature.

This basic calculator can be extended to a compact computer with an impressive capability.

**Price:** \$299.50

### POCKET CALCULATOR

A small pocket calculator will be available for less than \$100 at the end of this year.

Sales Tax on all Calculators is 15%

All units are built in Australia and sold with a full year warranty; service or parts are available at cost price.

Detailed brochures are available. 10% discount on 5 units.

W. H. K. ELECTRONIC AND SCIENTIFIC INSTRUMENTATION  
2 GUM ROAD, ST. ALBANS  
VICTORIA 3021

## Introduction Offer

### ELECTRONIC DIGITAL CLOCKS (TIMERS) IN COMPACT STYLISH CASE.

**Featuring:** Large LED's  
Selectable 12 or 24 hr cycle  
Individual time-set buttons  
BCD output

**Price:** With 4 LED's (hrs, mins) \$ 89.50  
6 LED's (same + secs) 104.50

Plus 2.5% Sales tax if ordered and used as a Timer only.

### ELECTRONIC DESK CALCULATOR

**Featuring:** 16 digit input and output capacity; and electro-flourescent display.

**Functions:** Addition, Subtraction, Multiplication, Division, plus One constant data memory

External printing and programming modules are under development, which can be added to the pre-wired interfacing feature.

**Price:** \$209.50

LETTER: Automotive Dwell clarified

With reference to the articles on Dwell Meters in the Dec 1971 EEB there appears to be a lack of understanding as to what dwell in a distributor system means. I hope that this can put a little more light on the subject.

Dwell is the period of the spark cycle when the points are closed, and is approximately 60% of the full cycle spark to spark, on normal distributors. On such systems it varies in time with engine RPM, for example for a 6 cyl. engine with a cam angle of 60 deg,

| <u>R.P.M.</u> | <u>Spark Cycle</u> | <u>Dwell Time</u> |
|---------------|--------------------|-------------------|
| 1000          | 20 m.sec.          | 12 m.sec.         |
| 2500          | 8                  | 4.8               |
| 5000          | 4                  | 2.4               |

Now, the time taken for the average ignition coil to saturate, to produce an optimum spark is 5 msec. So it will be seen that, from the example, a 6 cylinder system in good order will have a loss of spark intensity above 2500 RPM. This is due to the fact that with increasing speed the coil has less time to saturate, as the dwell time decreases.

This condition is, by the laws of time and motion, 25% worse for an 8 cylinder, and 50% better for a 4 cylinder engine than the example shown. Which is one good reason to favour 4 cylinder engines and/or Dwell Extenders.

-- L. Chaplin, Tanawha, Qld.

((In the abovementioned article, my reference was to Capacitive Discharge Ignitions, which are so much superior to the conventional system, even when the latter has a dwell extender. The subject of Dwell is of little importance in C.D., which requires very short condenser charge periods. -- RAJR))

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

LETTER: CD Ign for Motorcycles

I have noted in that illustrious opposition magazine, Electronics Australia many enquiries on the subject of Capacitor Discharge Ignition for twin-cylinder motorcycles.

These use separate points and separate coils. Therein lies the problem: how does one build a CDI system for same without going to the cost of building two separate systems?

I have been thinking on these lines for some time (as I have a "sickle" to put CDI on) but have encountered problems with stray firing pulses -- i.e., one trigger circuit sets off both coils, or the wrong one. A commercial unit will cost in the vicinity of \$80-\$100!!? Maybe if you could include a suggestion of this in your columns, it could start the ball rolling, and maybe some reader will come up with a suggestion? Up to the present, CDI is mainly on cars, but I myself know of many interested in CDI for motorbikes.

Congrats on your attention-getter in the April 1972 EEB, front page. I also agree on the comments on "Yankee Beer"; dishwasher would probably taste better! The Yanks should try

good ole Aussie brew -- they don't know what they're missing.

-- Richard Wilson (VK2ZVX), Miltthorpe NSW

((E.A. may indeed have opposition, but its not us! In addition to its usual interesting news about new developments, that magazine is again featuring quite a number of interesting electronic circuits of all kinds. It is instructive to see how the two Giants are shaping up.

Your comment on Yankee brew may have some point, but alas it is difficult to convince them of it. Good beer requires getting used to... We have quite a nice revised recipe that Jim Coote has sent (from England, of course), but to keep peace in the EEB family I'll have to save it for next April's issue--Ed.))

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

LETTER: On Automotive Matters

I agree entirely with Rod Reynolds on his comments concerning the Dwell Meter (Dec. 1971) The value of a dwell meter with CDI is only to check wear and tear in the distributor. An automotive servicing oscilloscope would pick this up more readily -- at a price. The vacuum gauge certainly has merit.

Talking of automotive servicing oscilloscopes, has anyone really thought what sort of frequency response is required in the vertical channel? The pulse repetition frequency varies from about 5cps to 500 cps, depending on number of cylinders, speed, and 2- vs 4-cycle. Allowing for transients, the required response shouldn't be more than, say 10kHz!

I have been interested in fuel consumption meters (EEB Feb 1972, D. Brown) for many years. Unfortunately, few cars now have electric fuel pumps, from which triggering pulses can be obtained. It is not necessary to include the pulses from the speedo if the engine tachometer is used as the other input to the MPG meter -- as long as a different scale is used for each gear in use.

From memory, the electric fuel pumps only operate every second or so, which would mean that the pulse inputs from pump and ignition system would have to be averaged over a few seconds to prevent violent fluctuations in the readout meter. I should be very interested if someone could work out how to meter the fuel electronically (and simply).

-- Rodney Champness, VK3UG, Warragul, Vic.

((For metering the fuel flow, why not one of those gadgets which turn around as the fuel flows past it, as was used in olden cars, and in olden petrol pump meters? But for all this I wonder whether it is worth it to make a running measurement of MPG? The vac. gauge tells you most of what you want to know in actual running conditions, and the adjustment of the fuel jets does the rest. We have a very very nice article coming up on the latter subject, by Peter Ward and Rod Reynolds -- if I can extract it from Rod. He has been exchanging correspondence with Peter about it for over a year, and its about time... -- RLG

-- by. R. S. Badessa  
(Damon Corporation, WI)

-- Part II: A Practical System

Summary of Part I (June 1972 EEB)

The Reciprocating Detector (RD) generates a synchronous reference from a carrierless double sideband signal (DSSC) by reversing the signal polarity in synchronism with the polarity reversals of the original modulation.

The process is made automatic by a form of regenerative feedback in which the generated reference is used to control the polarity reversals. This results in a synchronous band about one third the passband of the narrow band filter. The synchronous bandwidth does not depend on signal level, but for carrierless signals it does depend on the correlation between upper and lower sidebands. Signals with only partial correlation have a narrower synchronous range, and signals having no correlation, or having only one sideband are detected non-synchronously.

In no case (including the case of all random noise) does the generated reference have significant phase jitter. Its amplitude is a filtered version of the signal envelope and fluctuates at rates up to about 250 Hz. Part II will consider further the effect of these fluctuations and present some RD design guidelines.

The RD Reference Level

The output of a synchronous detector (or of a product detector) is independent of reference level provided the level is high enough to handle the largest signal excursion. In the RD the reference level is proportional to average signal level so that it is never necessary to operate with a large surplus of reference.

This has advantages. First, it minimizes the problem of preventing a strong reference from being picked up by low-level circuitry. Secondly it results in impulse noise rejection, even on SSB where the action of the SSB filter tends to stretch out impulses and make them difficult to distinguish from signal peaks.

Impulse Noise Rejection (fig. 7)

Impulse noise rejection here results from the inertia of the RD's narrow band filter, a characteristic that prevents an abrupt increase of signal level from resulting in an immediate increase of reference level. This lag between demand and supply has negligible effect on waveforms of the type normally encountered in speech communication, but an impulse is unable to muster the necessary large db increase of reference in such a short time, so it gets clipped.

The RD here acts as a rate-of-change limiter. The amount of impulse remaining after the clipping is a function of the gain of the regenerative loop. A high gain gives an abundance of reference and results in

poor impulse rejection. But an insufficient loop gain causes compression of signal peaks and may cause voices to sound "tinny". (If the reference is almost sufficient for the signal, outright clipping of peaks does not occur because the current gain of Q1 and Q2 of fig. 2 (Part I, June EEB) tends to increase with the drive from Q3)

The best gain is the one for which a moderate amount of compression occurs, since this guarantees impulse rejection without being so drastic as to have a noticeable effect on voice quality. If neither impulse noise nor stray pickup is a problem, there is no disadvantage in using a large amount of regenerative gain, since synchronous operation is not affected.

A Practical Design (fig. 3) (overleaf)

In fig. 3 is an RD consisting of a basic unit, a differential amplifier, and a narrow band filter. The filter is intended for operation at 500 kHz, but if operation at 50 kHz is desired the filter shown in fig. 4 can be substituted.

The two diodes D1 and D2 are always forward biased and were introduced to offset the loss of regenerative gain at low signal levels resulting from reduced current gain in Q3 and Q4. Ideally Q5 would be biased to cutoff so that application of the signal gives a half-wave rectified collector current. In practice the curvature of the characteristic of Q5 in this region makes it desirable to have a slight biasing current flowing when no signal is present. This current prevents the reference from disappearing completely in the absence of signal, but the reference so produced is small compared to the level generated in normal operation. The operating point of Q5 is stabilised with temperature by means of transistor Q6 and diode D3.

A FEW PRACTICAL SUGGESTIONS:

1) Choice of Transistors and Diodes in the Basic Unit.

The basic unit is designed to permit a variety of silicon transistors and silicon diodes. The type 2N3415 transistor and type 1N252 diode were used in most of the experimental units. ((Ed. Note: Transistor equivalents are Motorola type MPS6515, Philips BC108 or BC109 etc, Fairchild 2N3565 or 2N3566 etc)) ((The OA200 etc is equivalent to 1N252))

2) Rejection of the Common Mode Audio

The audio output of the RD is obtained from the difference of the voltages appearing at pins 2 and 9 of the basic unit. These voltages contain a strong common mode component that must not be permitted to overload the differential amplifier used for obtaining this difference. Excessive amplifier gain would cause distortion when the input signal to the basic unit is at the maximum permissible level of 3 volts

see also:  
-Techinfo-1  
-Topics-1  
-Rad Comm-  
6/72, p. 368

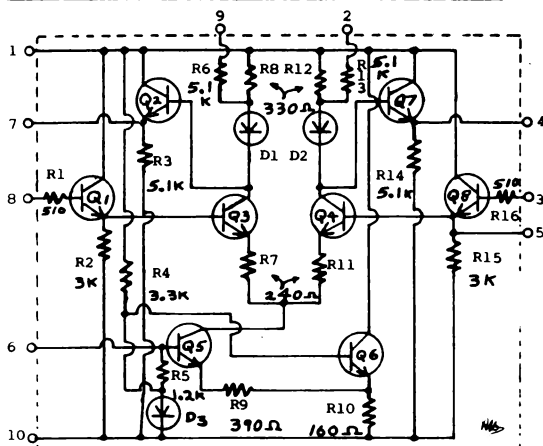


FIG. 3a: RECIPROCATING DETECTOR, basic unit

peak. The amplifier of fig. 3a is recommended. Note that the gain of the two inputs of the operational amplifier has been equalised with respect to ground.

### 3) Measurement of the Biasing Current

For good dynamic range, transistor Q5 should draw some current (e.g. 250  $\mu$ A) in the absence of signal. This no-signal current can be measured by noting the d.c. voltage appearing across the series combination of R9 and R10 of the basic unit with the signal from the i.f. disconnected. This voltage should be about 0.1 to 0.2 volt.

Too low a biasing current will cause distortion or even complete silence at low drive levels. Too high a biasing current will not cause distortion, but can cause loss of impulse noise immunity and synchronous bandwidth.

### 4) Specifications for the Narrow Band Filter

The narrow band filter, like the audio amplifier, is driven differentially, but its output is single ended. A convenient way to drive its input is by means of a coupling loop connected between pins 4 and 7 of the basic unit. If the filter is desired with a sufficiently low insertion loss, a loop gain of at least 3 can be obtained using no amplification other than that of the basic unit itself. To prevent excessive loading of the basic unit, the input impedance of the filter should be about 360 $\Omega$  or more. The filter bandwidth at the 3 db points should not exceed 500 Hz.

When the filter is connected to a signal generator as shown in fig. 5, the ratio  $e_o/e_g$  should be at least 3.5. Here  $e_g$  is the voltage at the terminals of the generator, and  $e_o$  is the output voltage of the filter under no-load conditions. When a 33K load is connected across terminals C and D, the voltage  $e_o$  should not drop by more than a factor of two.

### 5) The Sense of the Feedback

The RD is a regenerative device. Consequently the sense of the feedback may have to be reversed if it fails to develop reference. This can be done by interchanging the connections from the basic unit to the filter input.

### 6) The Regenerative gain

Too high a gain can cause the RD to lose a significant amount of its impulse noise immunity, particularly on SSB. Too low a gain can cause distortion.

A convenient measure of gain is the amount of reference present at the reference monitoring point of the basic unit when a known c.w. input signal is applied. This test should be done with the signal source detuned well off the centre frequency of the

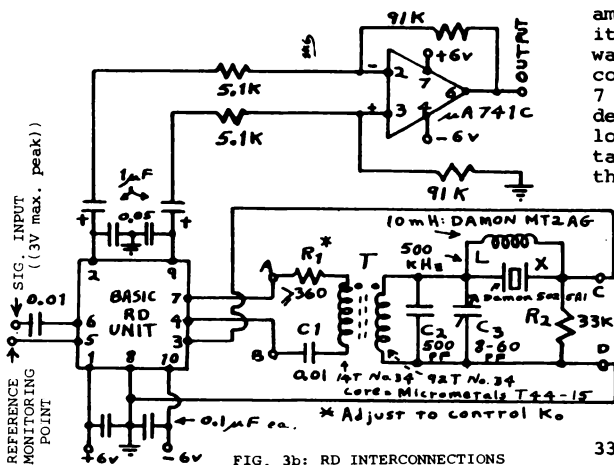
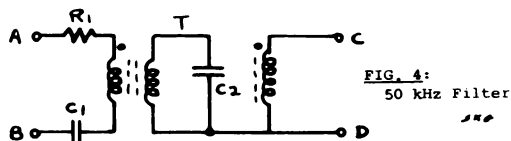


FIG. 3b: RD INTERCONNECTIONS

FIG. 4:  
50 kHz Filter

R<sub>1</sub>: Not less than 360 $\Omega$ ; adjust to control gain.  
C<sub>1</sub>: 0.1  $\mu$ F. C<sub>2</sub>: 3600 pF.  
T: Primary = 5t No. 32; Intermediate = 109t No. 31.  
Secondary = 43t No. 32; Core, Ferroxcube Number 1B11CA250 3B7 (or Aust. powdered core equivalent)

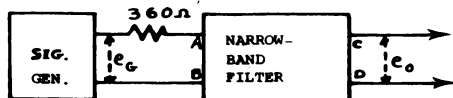


FIG. 5: FILTER TEST

narrow band filter and with a signal level which is large, but safely below the maximum allowable. A signal level of 1.5 V peak is satisfactory.

For this case the reference level required to achieve good impulse performance on SSB is about 1 V peak. For DSB or DSSC a level as high as 2 V peak will still give good impulse rejection, but you may want to experiment a bit with this. The gain can be adjusted by controlling the attenuation at the input of the narrow band filter, provided it can be done without unbalancing the drive. Usually the resistor  $R_1$  at the filter input can be chosen to provide whatever gain is required.

### 7) The Dynamic Range of the Input

The input signal level to the RD should not be so low that the reference level obtained with signal is not much greater than the level obtained in its absence. The maximum permissible signal level to the basic unit is 3 V peak. The average signal level should utilise a major portion of this available dynamic range.

### 8) The Balance of the Basic Unit

Rejection of impulse noise requires that in the absence of reference, very little differential output is available from the basic unit. This requires balance.

Balance can be checked by grounding Pin 3 of the basic unit while the RD is operating normally. This kills the reference and should reduce the audio output by at least 20 db. Note that a minor unbalance in the basic unit can be compensated for by trimming one of the 91 K resistors in the differential audio amplifier.

If you decide to build an RD, I hope that you plan to install an easily accessible switch so that you can make rapid comparisons with other detectors. The switch should have provision for disabling the reference oscillator normally used with the receiver product detector to prevent stray pickup from entering the RD.

-----  
Ed. Note: Figs. 6 and 7, below, have been added, as traced from a reproduction of the IEEE reference mentioned in Part I. I hope all the bits and pieces are there!

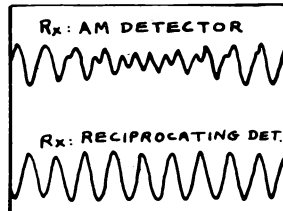


FIG. 6; (ABOVE): AM SIGNAL DURING A CARRIER-FADE.

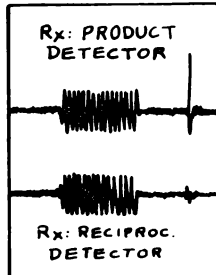


FIG. 7; (RIGHT): SSB SIGNAL WITH IMPULSE INTERFERENCE.

### L'AFFAIRE EOLE -- a French Goof (Ballsup)

-- QSP "Zero Beat" Mag., U.S.A.

-- QSP ARNS "Bulletin"/KÖNL

Very few classic "goofs" in the scientific world seem to receive coverage in the scientific journals, but the fantastic French fiasco of September 11, 1971 was happily covered in the October 1971 issue of Science.

Seems the French have this weather satellite EOLE, in orbit about 500 miles above the earth. EOLE's job is to relay weather data from more than 100 weather balloons, which have been launched from points in Argentina.

On commands from the satellite, the balloons transmit a whole blast of data back to EOLE where it is stored, then relayed to the Brittany centre near Paris.

To eliminate useless data from balloons which stray outside the area being studied, French engineers equipped the gasbags with explosive charges which EOLE could detonate on command -- singly, or all at once.

You guessed it! On the 346th orbit, French personnel (Murphy?) inadvertently sent up the "general destruct" command instead of the "interrogate" command. Seventy two expensive sophisticated weather balloons augured into the South Atlantic.

We understand "procedural changes" have been initiated at mission control.

(ARNS Ed. Note: We note in the daily papers that the system used for (air raid) warning in the U.S. has now been discontinued since a fellow by the name of Murphy got ahold of the wrong tape and directed the radio stations of the U.S. to sound a general warning. The system has been discontinued.)

### ITS TOO HOT IN THE SAHARA

"The nuclear weapons will be tested as far as possible from France because they are too dangerous. There is too much shipping and too many people around France; the Pacific area will be better for the tests".

-- The Consul-General of France,  
Melbourne, 13th June 1972.

((I understand that recently the French have been most upset because some European countries have been wanting to bury radioactive waste from their atomic piles. The French are worried lest said waste leak into France; I wonder where the French dump their own radioactive stuff -- in the Pacific, perhaps? --RLG))

### THE CAGE ANTENNA STILL LIVES!

((From: Collector/Emitter, April 1972))

Those who think the cage antenna died a natural death before 1930 should read about an antenna used by the Army for testing the immunity of equipment to the electromagnetic surge produced by an explosion of an atomic bomb. This little trinket is a thousand feet long, 65 feet high, and is a multi-wire cage 30 feet in diameter, tapering to a point at each end. The taper is on the last 100 feet. To simulate the effect of an atomic explosion, the Army slaps this antenna with 7,000,000 volts from a huge capacitor! Katy, bar the door!

## A NEW LOOK AT OLD I.F. AMPLIFIERS; The Usefulness of Hybrids -- C. Pitcher (VK3)

### Transmogrfifying an Old Radio

I recently became the proud owner of an old Mantel-style radio. Being built in the '50s before obsolescence became the watchword ((1850?? -- RLG)), it is quite well-designed, particularly the mechanics and will doubtless provide the basis for an excellent radio.

Instead of just stripping it down and rebuilding it, I decided to learn a little along the way, and replace things a bit at a time, trying to improve (or even match!) the original performance. The results so far have been rather interesting.

### The Audio Amplifiers

Naturally, the A.F. amps went first, to be replaced by standard transistor versions with lowish power output. That doesn't bear comment except that it gave me an amp or so of heater current to run everything from, and blew the filter capacitors up from the lack of HT load. When things returned to normal, and I coaxed the wife out from under the bed, I started on the I.F. Amp after taking a look at the Converter.

### The Converter

The original circuit was fairly standard: a converter valve, one I.F. amp and two audio valves. Under Melbourne conditions on the Medium Wave band, there was just barely evidence of cross-mod. at the top end. Replacing the original aerial coil with a ferrite affair cured that, so presumably the converter was at fault. So much for the converter.

### FET-ising the I.F., with good AGC

My first attack on the rest was to wire in an FET in place of the original pentode I.F. Stage; see fig. 1. After adjusting the neutralisation the gain appeared to be much the same as before, but the crossmodulation made most stations unreadable. By detuning the input

transformer, it was improved some. This was probably due to reduction of the AGC (Automatic Gain Control) voltage, since the gain was reduced.. So I went looking for a better AGC system. The "hybrid" method was tried, with a transistor in the source lead. Like magic the cross-modulation dropped to nothing. This was lesson No. one.

Still pottering around, I next tried the cascode circuit, with an FET and a transistor, and reverse AGC to the base of the transistor ((If you need background for this kind of thing, take a look at the excellent summary of theory in the front pages of the RCA Transistor Manual -- RLG)). This was better than the FET alone, but cross-modulation was still there on strong stations (i.e., high AGC voltage). The hybrid method again provided a solution; see fig. 2.

At this stage I was able to dispense with the neutralisation (thus saving one capacitor!), but more important was that the gain was higher (as evidenced by improved performance with weak stations) and the selectivity noticeably improved (viz., less highs in the audio). I presume this was due to reduced loading on the second I.F. Xfr, and

of course)

(ALL I. F. TRANSFORMERS, "IFT", ARE SHIELDED AND EARTHED,

FIG. 1: FET Amp. with hybrid AGC (To feed from low-R, Q3 may be omitted). Q1 = National NF 501 (IPSS  $\approx$  8mA), MPF102, etc. Q2 = Any silicon NPN. Q3 = Q1 (Vp  $\approx$  1.2V; AGC delay).

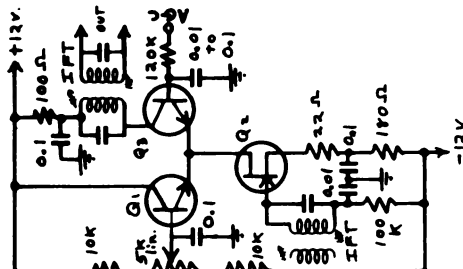
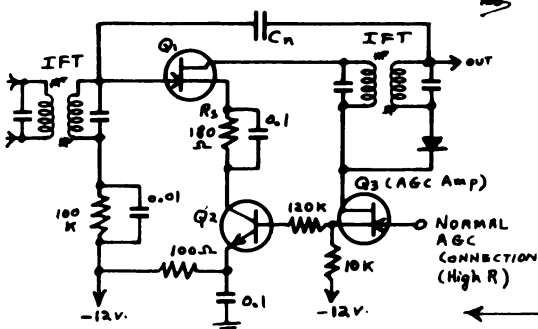


FIG. 3: Preferred Cascode with internal AGC. VBI sets AGC delay

As Drain

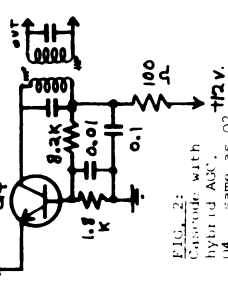


FIG. 2: Cascode with hybrid AGC. Q4 same as Q2

probably due to imperfect neutralisation beforehand. To prove or disprove this, I interspersed a buffer between the I.F. XFR and detector. It didn't prove much, although the selectivity may have sharpened slightly, so feel free to draw any conclusions you wish!

#### A Useful Rearrangement

The final step was to take the AGC transistor from the emitter of the FET, and place it in parallel with the other transistor; see fig. 3. There was no noticeable improvement in anything. In this case, however, the transistor could conceivably be replaced by a diode, and it was possible by adjusting RV<sub>1</sub>, to set the AGC delay rather nicely.

So there it is. I think I have improved the original; one day I will measure it and find out. But at least I have removed any nagging doubts about the superiority of valves over transistors. To my mind, anyway, it is not the device so much as the way it is used. But it is true that the transistorised A.F. stages did allow a more efficient use of power.

#### Editor's Note

I have a M/S about a somewhat similar conversion I made to an old farm radio, but Chris's is probably better. But the fallout from it resulted in our set of articles in 1970 about the proper design of complementary-symmetry a.f. output stages, because my initial power output attempt was with Fairchild's 3W design -- the one using no bias between the transistors. It sounded terrible, and some liaison with a friend here and in Victoria yielded the improved designs of 1970. \* See

In a previous radio, the transistorisation of the a.f. output stage was vitally necessary, because without it the power transformer ran stinking-hot; enquiry to the (American) manufacturer revealed that (after the doubletalk) that was supposed to be the operating temperature of the transformer! Presumably, complete with the smell of burning insulation.

Chris had considerably better results than I with the i.f., but one useful thing I found was that an untuned r.f. stage could be added to good advantage. An FET with 10K in the drain and a few K in the source worked fine. I used 100K in the gate; Rod said this introduced noise, but lowering the value of that resistance only reduced signal level without improving anything. With the r.f. stage, quite a lot less aerial was necessary.

In this particular case, however, the farmer was plagued by fierce mains noise, and the r.f. amp allowed the use of a home-made ferrite-coil antenna. This

performed every bit as well as a long wire (Melbourne stations at night, no difficulty), but featured a greatly improved rejection of the mains hash. That's a thought to keep in mind in noisy locations. Rod says it's no good for short wave, because it's mainly affected by ground wave transmission -- but those Melbourne stations must have a long ground wave!

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

#### THE HUMAN SIDE OF TVI

-- by Al Fischer, W7UV

((Reprinted, in part from the Bulletin of the Amateur Radio News Service, May 1972))

... I have no TVI, but I get into the phono hi-fi sets of most of my neighbours. So far, all the neighbours are nice, but they won't be nice forever. Now, this is a problem as old as amateur radio itself.

Some amateurs ignore the neighbours, some buy parts and install same on the hi-fi, still others simply tell the neighbours to call their service man. BUT WHAT WOULD YOU DO? The answer to my problem is the prime number one factor governing public relations images created by amateur radio (in the absence of an emergency) with the general public. The WRONG answer to the problem destroys years of good public relations efforts, and the greatest mistake any amateur can make, public relations-wise, is to use the incorrect approach.

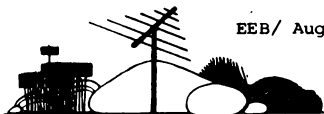
We have been told NEVER to touch a neighbour's installation ourselves. We have been told NEVER to take an arbitrary approach with a neighbour or to ignore him. On the other hand, it takes the diplomacy of a professional (which few of us are) to convince the neighbours that it is a fault of their own hi-fi installation.

The neighbour only understands that all was peachy keen until THAT amateur moved into the neighbourhood, and so why should he hire a serviceman to bypass the speaker leads and the AC line on his Japanese solid state Hi-Fi?

If any of you have an answer that you're truly not heard of nor read after 43 years on the air (and I have not heard all the answers or know them), well, let me hear from you and I guarantee the editor will print them in the next Bulletin.

-----  
EEB Ed Note: The Amateur Radio News Service is an association of editors of radio publications of all kinds. They and their interesting Bulletin aim to help other editors improve the quality of their publications. We have received a considerable amount of help, advice, and useful ideas from them. If you are involved with any kind of publishing activity, you will undoubtedly be interested in the ARNS. Enquiries may be sent to the Secretary: Rose Ellen Bills, WA2FGS, 17 Craig Place, Pennsville New Jersey 08070, U.S.A.

XXXXXXXXXXXXXXXXXXXXXXXXXXXX



## TRANSCEIVER RECIPROCITY AND RECEIVER COMPLEXITY

### A SQUARETABLE

((Being a Discussion between Winston Henry (VK 7WH) and Leo Gunther (VK7RG) with asides from Richard Ferris (VK7ZDF). ))

#### Phasing-Exciters

W: I'm building that neat improved version of the Tucker-Tin SSB phasing exciter which appeared in the August 1971 Break-In\* ((The original, rather simpler version of this was reproduced some years ago in EEB (valves, 1968; transistors, 1969))). I'll follow it by a transistor linear amplifier with perhaps some 15 W PEP output.//\*\*Followup 10/71, 5/72. Summary in Tech Topics, Rad. Comm., July 1972, p 451.

L: Why not use valves in the final? Simpler, less worry about nasty parasitics, transients, neutralisation, etc?

W: No, I want this to be portable as necessary.

L: Carrying the battery in a Back Pack?

W: Well, I can use a reasonable dry battery, and simply not modulate so heavily.

L: Why not just put the exciter on the air?

W: Its only milliwatts.

L: All right, but say you take 2 W from your final, thats only two S-units better than 100 mW, for ten times the power drain.

W: Well -- its only peak power.

R: Peak power or not, its still a stupid argument. Why not use only 10 mW? After all, it will "only" be 2 S-units down from 100 mW...

L: Arguments by themselves are never stupid! A couple of S-units may not be major, but double that might be significant.

I admit, however, that I am simplifying the picture. For a home-installation where power is no object, 100 W are 3 S-units "better" than 1 W, and valves do the job easier and cheaper than transistors. On the other hand there exist the "QRPP" enthusiasts who maintain that "power is no substitute for skill" and who delight in achieving 1000 or even a million miles per watt. It all depends what you wish to make out of amateur radio.

For Winston's portable system, however, performance must be balanced against weight and size. It takes rather more batteries to deliver 100 mA than 10 mA, and obviously a 1A load is not as portable as either.

Empirically, some 100 mW will give quite a lot of coverage if it feeds a reasonable antenna. If the antenna has to be carried on the back, that figure might go up to 2 W so that those two S-units are not lost. If, say, the average level of your signals received at the other end is about S6 (or say, "10db above S9" in modern language), you might be willing to reduce power 20-fold to bring it down to S4, but below that you would get into difficulties unless you were operating CW.

Thus it resolves down to the amount of batteries you are willing to carry/afford, to antenna efficiency, to the band used, and perhaps to your diligence with low power!

#### With Direct Conversion Receiver

L: What about the receiver?

W: I thought I might use a Direct Conversion receiver. Its simple, and I could use the same oscillator for BFO as I have in the exciter (with a bit of conversion).

#### With Good Audio Selectivity

L: Ummm, perhaps. But of course you'll want to use an audio filter with a good bandpass shape factor, as we've been discussing in the EEB articles. The Chebyshev response one in the 1971 ARRL requires only 4 88mH toroids.

W: Well, yes, all right.

#### And Phasing-Detection

L: And then there's the problem of audio image -- nasty if QRM is heavy within a few kc\* of your signal.

W: Yes, but that can be phased out, can't it?

L: Just so, and in fact we're talking about that in the EEB (if it ever gets published); I'll show you the relevant books on the two-phase system, or "Signal Slicer" (EEB, 1969, p. 100).

W: Very interesting: No reason why I couldn't use the same components for the receiver phasing detector, as for the transmitter phaser, is there?

L: That's right. In the transmitter, audio is stripped from a sideband by opposite-phasing, and transmitted as a signal. In the receiver the signal is detected and turned into audio stripped of a sideband. Just the same process.

Not only does this eliminate half the QRM in your bandpass, it also increases S/N ratio of a SSB signal by 3db (every bit helps, Dick) It also allows painless reception of DSB, and even AM by the exalted-carrier principle. Receiving both sidebands of AM on a product detector is awkward because of the need for the L.O. to be in phase with the received carrier. That this can be done at all implies only that the Local Oscillator is being locked by "pulling" from the received signal. This is in fact done deliberately in Ref. 33 of our current series of articles.

#### Phasing for both Tx and Rx

W: It sounds like a good idea, and from these valve circuits you're showing me the "Signal Slicer" doesn't look too complicated. No reason at all why the same circuit can't be used from the exciter, run backwards.

L: Yes, but you can't really do that literally. The inputs and outputs would have to be switched around and that could be awkward. In addition, the requirements for linearity of the receiving product mixer would be rather more stringent than for the transmitting one because of the greater dynamic range needed.

This might suggest the use of a couple of Dual Gate MOSFETS for the mixers (replacing the diodes of fig. 11 in my State of Art article) You could use the same L.O. and r.f. and a.f. phase shift networks as for the Tx, but you'd either have to switch to a different audio amp or switch input and output of the Tx one. I shouldn't advise the latter, because of the high a.f. gain needed. High a.f. gain can be

\*In conversation I refuse to use hertzeses!

W: All right, but those phase-shift networks are tricky, and it would be well worth switching them from Tx to Rx. And the same oscillator stability can be achieved on Rx as for Tx -- and that is important.

L: Ah so, but remember that that oscillator should have a clean sine wave output, or you may be receiving 7Mc Peoples Radio on top of 80M signals (or 20M California KW's on 40M).

#### And an R. F. Stage

W: Why not merely add another tuned circuit at the r.f. input?

L: It increases the complexity of ganging the tuning. And in addition it is really quite a lot more effective if you pop an FET between the tuned circuits. And you could improve results even further by using an r.f. Q-Mult. or controlled R.F. Stage regeneration (harder).

W: More r.f. selectivity would also help to reduce crossmodulation from adjacent strong signals, as long as r.f. gain is kept low.

L: True, but that r.f. stage will also introduce a little noise, and even more if regeneration or Q-multiplication is added.

R: Regeneration may increase noise, but it also increases signal: The SNR is not affected unless you operate very close to oscillation.

W: In any event, a good FET introduces low noise. And it allows good AGC control -- otherwise how would you get AGC on a Direct Conversion receiver?

L: Audio AGC.

W: But that won't keep strong signals out of the mixer.

#### And a Linear Mixer

L: Use a linear mixer, like a beam-deflection valve, 7360 or similar.

W: This setup can't use valves, so I'll have to use the best available semicon mixer.

L: Then use Hot-carrier Diodes, though they have the disadvantage that they require balancing transformers for a doubly-balanced configuration, if you're to get the lowest amount of harmonics and feedthrough.

W: The DG MOSFETs might be simpler, and if r.f. gain is kept very low as Dick suggests, the mixer should be able to take the normal range of signals on the bands.

#### And a Buffer

L: A further refinement could be to add a buffer stage between oscillator and mixers.

W: Why?

L: To reduce the effect of "pulling" on the L.O. by incoming carriers.

W: But the only signals will be sidebands, no carriers.

L: No, a sideband is just a carrier whose frequency and amplitude are varying at a certain rate. You can have pulling of a L.O. by a strong adjacent-signal sideband, with the consequence that the L.O. frequency is modulated by the audio of the QRM. You can imagine what this does to the desired signal!

R: That's what I said.

L: Yes, certainly, where do you think I get all these bright ideas?

W: Perhaps the buffer might be useful, we'll think about it. Simpler first to try it without the buffer and see what happens. After all isolation ought to be pretty good between the gates of a Dual Gate MOSFET.

#### And a Good Audio

L: Perhaps. Try it and see -- and let us know the results. I might add only that you will need to be very cautious about avoiding internal transistor noise and external audio pickup, because of the very high a.f. gain needed. You can take care of the circuitry by using an I.C. for the audio amplifier, but G3VA (in "Technical Topics") has suggested that superior results might be achieved by using discrete amplifier stages having bandpass filtering on each stage. This can also do wonders for the shape factor of the audio response, if intelligently designed.

W: The result of all this should be a pretty good receiver.

#### So what happened to the Simplicity?

L: Indeed, but what has happened to all that "simplicity" the Direct Conversion Receiver is supposed to have? For comparable performance you need comparable complexity. Simple D-C simply has the advantage that you get somewhat better performance for the same number of components than you would obtain, say, from a good Regenerative Detector (and on CW they could be comparable!).

W: But D-C would appear to have the advantage that the (audio) selectivity is placed very early in the receiver, right after the one and only detector.

In a Superhet the maximum selectivity is obtained only at the end of the i.f. strip, so allowing the possibility of i.f. overload within the r.f. passband. Pat Hawker has quite a lot to say about this in Amateur Radio Techn.

#### Back to the Superhet?

L: All right, but it's not fair to compare the two circuits unless you do so under comparable conditions! In the D-C, the pre-selectivity gain is kept low, and highly linear mixing is used. As Pat Hawker mentions, you get the same results when r.f. and i.f. gain is kept low in a superhet using similarly linear first mixer(s). See also the fine discussion on this subject by Peter Martin in early 1971 issues of Radio Communication ("Plagiarise and Hybridise")

W: In a superhet you have the problem of r.f. images (and 2nd harmonic images). If you use double (triple, even!) conversion to avoid images you invite a lot of "birdies" from the harmonics of all of those oscillators.

L: Modern technique is returning to single-conversion, with lots of selectivity (from mechanical or crystal lattice filters) at high i.f., and right after the first mixer. This avoids both the images and the birdies, and also avoids i.f. overload. Additionally, up-conversion (converting to i.f. higher than the signal) (see Am Rad. Techn. for interesting application via varactor diodes) renders oscil-

lator harmonics harmless.

The picture is completed by low noise low gain r.f. stages, and mixers biased for good compromise between sensitivity and linearity (See QST for Jan and Feb 1972). Thus, superheterodynes having good performance are becoming simpler (and better), while good Direct Conversion is getting more complicated.

Murphy wins.

A Direct Conversion set is simply a superhet with zero i.f.: I.f. amplification is replaced by a.f. amplification. It is "better" only if it is easier to achieve high gain and low noise in a.f. stages than at i.f.

It isn't.

But Direct Conversion is still better -- sometimes

W: You've presented a pretty convincing argument for the superheterodyne, but you've overlooked something: A simple D-C will give quite satisfactory performance, and we have seen this in Ron Brown's (VK7ZRO) neat little unit. A simple superhet will give terrible results because of r.f. images, though I'll admit that it is worthwhile to use good selectivity filters for either.

A simple D-C is not troubled by r.f. images (the L.O. freq same as signal freq), and for the sake of simplicity it would be worth a little trouble to build a L.O. with low second harmonic content.

L: I suppose so, say a push-pull oscillator, or an ordinary Vackar or Seiler with some degeneration; the latter are reported to have "amazing stability" as well. A typical good, low harmonic Seiler Osc appeared in the Jan 1972 Ham Radio.

W: The main point is that I want only a simple set for my mobile operation, one which is compact and easily portable -- and reasonably easy to build.

The D-C fits this requirement better than the superhet, and I'm willing to accept a few limitations on performance. On the other hand I see no reason why I shouldn't be able to use the phasing components of the Tx on the Rx, and for only a little extra complexity add the "two-phase" detector. It will slice the bandpass in half, and that's impressive. With that one refinement it is certainly going to perform as well as most superhets, and better than many.

L: But surely not better than a superhet also endowed with a "signal slicer"?

W: Perhaps not, but that addition makes the already complicated superhet even more involved. With the D-C without an R. F. Stage I can still get good results if I have a linear mixer. Superhets without R.F. Stages are useless for serious work. And to get good results from R.F. Stages you have to go to a lot of trouble, as Blakeslee shows in the Feb 1972 QST.

Under dire conditions of strong signal QRM I could still pop in a switched r.f. attenuator. One of the big advantages of the D-C system is this flexibility: the basic receiver is good, and complex ones are even better -- with a wide choice of refinements. The superhet has to carry a lot of baggage merely to work.

R: It seems to me that Winston wins this argument on the basis of simplicity. A D-C can be more effective when simple than a superhet for the sole reason that the i.f. of the former is zero, so if there is no serious QRM within the audio passband, there is no problem of images even without an r.f. stage.

If there is serious "audio image" the use of the Tx phasing network on the Rx will phase it out, as he suggests. This results in reasonably high performance for a portable mobile system.

L: Why should the question of portability be so relevant here? Surely a couple of small i.f. transformers hardly impose a crushing burden?

R: One of Winston's requirements was that it "be easy to build". If it gets too complicated that requirement is not filled -- and better a simpler set that gets built than....

L: All right. You build into a system the degree of complexity consistent with your requirements for performance, and with your ambition. Life always involves "tradeoffs", and the argument here is quite analogous to the one about power levels, at the beginning of this article. But let us be disabused of the notion that by use of some magic design we can get "something for nothing".

W: A bird in the hand is worth two in the oscillator...

XXXXXXXXXXXXXXXXXXXX

TELL THIS TO YOUR XYL ((VHF News Bull. 5/71))

"Wireless World" for March 1914 reports that "The demand for female domestics, both in Australia and New Zealand, appears to be imperious and practically unlimited. In some cases, before a ship carrying women migrants sights the land a large number of its passengers have been engaged by wireless telegraphy."

The writer concludes with this punch-line which is worth quoting out-of-context:

"To the colonial housewife wireless is, therefore, a boon which she probably never contemplated."

XXXXXXXXXXXXXXXXXXXX

#### Quote

"It seems to me that our mail service may well be headed for extinction. As the rates go up and the deliveries go down, something else is bound to take its place. Of course I feel that the post office could easily be automated if they had the inclination. By standardizing on an envelope size and authorizing a simple addressing machine which could be read by a computer ((directly)), they could get most of the mail in shape so it could be sorted and handled entirely by machine. A special low postage rate would force all commercial users and prudent private persons to use the new service. ((EEB emphasis))

"The addressing machines could vary from a \$5 Dymo type contraption, to regular typewriters. I'll bet they could turn them out to sell for \$2..." (etc etc in same vein)

-- Editorial, 73 Magazine, October 1968.

XXXXXXXXXXXXXXXXXXXX

We have recently received a Catalogue from "HAL Communications Corp" and from "Babylon Electronic Equipment Company", also mentioned on p. 35 of the April EEB.

HAL offers several kits of special interest to RTTY enthusiasts, and both of these typical "basement electronics" firms offer a wide range of components of all kinds, from ICs to transistors and small components. Both solicit customers in the USA and abroad. Both are typical of several other firms abroad, as advertised in the various magazines.

A. G. Adams' assertion here last month certainly seems to be justified that the parts are available if one looks abroad. Yet there is a consistent complaint to the contrary. We read about it in the Yank magazines, and it is sent to us in personal correspondence. We reprint a typical one herewith, from the USA, and some contrasting information from the U.K.:

USA

((From a Prominent Amateur))

"With the demise of ... there has been an abrupt end to high-level electronics kit building and experimentation in the USA. It doesn't sell advertising..."

"...The IC-makers, the transistor manufacturers and electronic component distributors are making it more and more difficult for the experimenter to tinker around the shop. As you probably know, old reliable --- has been taken over by ---, and the industrial electronics division has dropped several important manufacturers (or probably more likely the manufacturers, notably --- have dropped them). Nevertheless, it is getting very difficult to buy parts to do any construction. This has resulted in a whole new batch of basement electronics distributors like HAL Devices and Semiconductor Circuit Specialists, Babylon Electronics, etc. They take care of many of the special parts, but what happens when the average experimenter wants to buy a --- IC, --- SSB/CW/FM i.f. strip IC, or some other bit of exotic hardware? He's up the proverbial creek without a paddle!/-..."

"Darn few beginners build their own equipment, in the USA at least. And how many hams build their own receivers or transceivers? Many build linear amplifiers but only a very few build receivers, exciters, transceivers, etc. And with the explosion of Japanese 2-meter FM gear, the interest in building VHF equipment approaches zero. It is a sad spectacle. To make matters worse, even if you wish to build something, it is nearly impossible to purchase parts. More and more distributors are only handling industrial accounts, as over-counter sales are time-consuming and hams are a pain in the neck anyway. ---, one of the greatest outfits in the world for mail order, has been taken over by --- and is going out of the mail order biz... I may be over-pessimistic, but amateur radio in the USA is going through a profound revolution. Between the influx of appliance operators and the flood of cheap Japanese gear -- aided by the general inability to obtain components -- I see that the home builder of electronic gear will be as extinct as the home builder of automobiles or

fridges or TVs. If you want to build (you eccentric, you!), why just order from your Friendly --- Kit Catalog."

From a recent QST Editorial

" 'You fellows aren't amateurs any more,' the comment went. 'An amateur is supposed to be primarily an experimenter, to build his own equipment, to try out new circuits, to develop ideas. You did this years ago, but no longer. All you do is lay out a few hundred dollars and buy station equipment entirely commercially made. When something goes wrong, you even send the unit back to the manufacturer for repair! You are not amateurs; you are just communicators. We can't afford frequencies for such activities.'"

-- A delegate to a frequency conference  
((See also EEB Oct 1971 p. 85 upper left))

((I am tempted to quote from O. P. Ferrell's Editorial in the Feb 1971 Popular Electronics, but by a coincidence Mr. Ferrell is no longer editor of that august journal, and I'd better not... -- RLG))

U.K.

From R. F. Stevens, G2BVN:

"I have discussed the availability of components with several of our members who are in the professional field but unfortunately none of them would commit themselves on paper on the question.

"Those to whom I have spoken all agree that at the present time the supply of components in the United Kingdom does not present any problems. One of the factors affecting the position has been the entry into the market of large distributors who hold considerable stocks from all the main manufacturers. Not only are they prepared to supply in large numbers but will also supply in small quantities for development and prototype purposes.

"I gather, however, that the position has not always been as satisfactory as at the present time, and up to as recently as a year ago there were considerable hold-ups in production due to the delay in the supply of components. I understand that this applied particularly to certain types of capacitor."

From G. V. Haylock, G2DHV; and from G2BVN:

((We have received from G2BVN, extracts from "Electronics Weekly" ("The Technical and Business Newspaper of Electronics and Communications", Dorset House, Stamford St., London SE1 9LU, England), and from G2DHV an entire issue of that newspaper. It contains news about the electronics industry (of the sort one might read in the financial pages of The Australian), together with adverts for equipment and components, and a precious section marked "Prices and Deliveries", a "single source of information showing prices and delivery times for a cross-section of commonly-used (components)" of various types. G2BVN wrote:

"There has been considerable concern here at the lack of available supplies to back up manufacturers' promises. As a result of the debate Electronics Weekly now publish a series of availability charts..."

# From "Radio Communication" (RSGB)

((This magazine regularly announces various items under the "Catalogue Received" listing, and in the editorial "QTC News". Thus, to take a couple of items from my files, in the Dec 71 issue, it was the "Home Radio Catalogue"; "The purchase of components... is an ever increasing problem. Manufacturers are unwilling to sell in small quantities where the overheads are said to be uneconomic. To try and overcome some of the problems, Home Radio has formed a buying group with other component dealers..." etc, with numerous advantages (240 London Road, Mitcham, Surrey CR4 3HD, England).

((In the August 1972 Rad. Comm. the Catalogue was that of Electroplan Ltd (PO Box 19, Orchard Road, Royston, Herts SG8 5HH, England) supplying various accessories.

((I would note, however, that in marked contrast to the American radio amateur magazines (where the Parts Availability Crisis is said to be worse), out of 35 advertisements in the August 1972 Radio Communication, 23 were for commercial-amateur equipment, 6 were for modules, and 6 were for components, with a slight amount of overlap in some instances--Ed))

## AUSTRALASIA

### From an Australian correspondent

"Even here parts have begun to become scarce, though rather more in lines of merchandise handled by Australian outlets of the big American firms. Still, from the whinging overseas it looks as if parts are still more abundant here than over there. Why don't you suggest to your overseas readers that they import their parts from Australian suppliers?"

### From an advertisement

"Fed up with temperamental home brew gear? Then now is your chance to clean up the shack and join the DX hunts" ((by buying a good commercial transceiver)).

## NOW BACK TO RLG

This is a strange picture? Parts are available parts are not available, advertisements show an abundance (see the pages of Wireless World) while manufacturers are said to have difficulty supplying, the situation has improved compared to a year ago but retailers are being forced into cooperatives to survive...?

What is the truth? Is there any point in importing components from a scarce market overseas to a reasonably abundant market here? And the market in New Zealand seems to be about as well supplied as in Australia, to judge from adverts I see in Break-In and in Electronics and Communications -- and from a lovely "Directory of N.Z. Electronics" kindly sent to us by the publishers of the latter-mentioned magazine.

Will the present availability of parts here dry up soon in reflection of overseas trends?

It appears that the question is not that simple. One reason for the apparently better situation here may be the greater resourcefulness of Australasian experimenters in adapting

components available; this seems evident by comparison with the American experience as described by Doug De Maw in the July 1972 QST ("The Ailing Emporium"), and Yankee affluence may have affected the British as well.

Additionally, Rod has pointed out to me that there are still distributors here who are small enough to be willing to handle merchandise on the limited scale we require, whereas De Maw points out (in the QST article) that

"It is ironical that we live in a time when state-of-art components abound, yet they are earmarked for the high-quantity commercial buyer..."

A further problem exists seemingly in an opposite direction, the large variety in type numbers of components having similar or identical components; this has been summarised by Jim Fisk in his Editorial of Feb. 1972 (in Ham Radio). Again, however, our experience is more favourable in this regard, since on one hand we have a smaller range of material available, and on the other Australasian experimenters use common sense in adapting available material to recommended material; otherwise how could they make sense of the overseas literature?

Lastly and not at all leastly, some new information just available has altered the Australian, and indeed world, position in these matters -- affecting not only components but the electronics industry in general. In the past week or so (early October) that Industry has been in an obvious and agonising state of flux. These developments will be considered by some of us in the next EEB.

Indeed, I have had to rewrite much of this page just before going to Camera, because a detailed analysis of the Parts Availability situation by Rod Reynolds here will need to be rewritten, and I don't want to delay publication on that account. By the time the next issue appears, matters should have stabilised somewhat, and a more accurate prognosis of the parts-availability situation will be feasible.

.....

## QUOTES (Perhaps relevant to matters on p. 75 ...)

"Sir John Masterman is a distinguished author and historian, former Provost of Worcester College, Oxford, and Vice Chancellor of that University. He was wartime deputy chief of MI5 -- academics, it seems, were found to be eminently suitable for the work." -- Newspaper report reviewing the author of "The Double-Cross System of the War 1939 - 1945"

"A laser beam is being developed with 'death-ray' potential. A strange technology indeed, where the defence against such a weapon would be a polished mirror 'reflecting the laser ray back where it started -- with devastating results'... But research is going ahead at a 'healthy rate', and scientists are confident that the main difficulties will be overcome.... "But the scientists in New Mexico -- and their Soviet counterparts at Novosibirsk in Siberia -- must all be hoping that the 'death ray' will never be turned against anything more deadly than the pile of oil drums in the foothills of the Munzano Mountains." -- paraphrased somewhat from a newspaper report, 25/3/72.

"We can make this country into a quarry to serve the whole world... Pollution is important, but not as important as a million-dollar industry." -- Sir Henry Bolte, Sometime Premier of Victoria (Australia, where else?)

### This & That; droll humour

Nearly as funny as Sir Henry is the suggestion made seriously this month, that to solve the recurring Problem of the French nuclear weapons tests in our backyard, Australis ought to send a Task Force into the Test Area to daunt the dauntless Gauls. Can't you see it? I reckon the possibility is slight that there will be civil war between the French and their military customers here....

Less funny, maybe, is the progress toward the establishment of a uranium-diffusion plant, probably in electrically-operated Pedorless-Tasmania. I suppose that the peace-protesters will miss the point of that too. It seems rather more likely that the principal nuclear weapons targets would not be the factories (which would already have produced their nasty load), but the people responsible for them: Me and Thee. Wot a world.

### Blow Here to Inflate (or: How Pleasant it is in Canberra, heigh-ho, how pleasant it is.....)

Whilst we're considering absurdities, the Inflation flames afresh, fed by blind self-interest on every side (but oh its still better than the 10% per month being enjoyed in a South American country at present!).

This hasn't inhibited our national Representatives in Canberra either, who have cunningly managed to promise the earth AND to reduce taxes. I reckon it will get them elected again (and again and again...), but I'm willing to bet that the First Law of Thermo applies even to politics: "You ou never get something for nothing". The Second Law says, incidentally, that "Geese never lay Golden Eggs -- or hardly ever". We'll see.

### How to get Something for Something

In welcome contrast I am struck by the lucid treatment of the TBA651 Multipurpose IC, as described (probably by Tony King) in the August 1972 issue of The Radio Bulletin (Reviewed here in April 1972, p. 40). This is somewhat relevant to our big discussion of IC-technology last month -- about which reservations may...

In any event, here is a presentation of an IC and its functions in EXACTLY the manner I have always admired (but rarely seen). Instead of the usual Black Box producing 16 pins to a Model Circuit, here we see a thorough analysis of the circuit functions in the B.B.

-- one by one -- showing how they can be applied to specific functions using discrete component analogies. This allows us to understand how the IC works, and thus apply it to a variety of circuits -- not merely the pet one chosen by an author. Would that the Handbooks adopted this approach too.

The TBA651 is the whole front end of a receiver, and when combined with another STC unit (e.g. TAA611/B or TAL011 an entire receiver! Gadzooks. Tony not only describes each circuit function (including a P/S regulator), but supplies curves and quantitative data with performance figures. Lacking, however, is some indication of strong adjacent signal rejection capability, called to question because of the exclusive use of bipolar circuitry (though degenerated by f.b.)

In that same issue of the RB, incidentally, he also shows a nice design for yet another unneutralised Dual Gate MOSFET r.f. amplifier stage; ARRL please note. The widespread availability of the protected DG MOSFET, HPF121 at low cost now makes such r.f. stages (and the rest) very practical. I note, for example, that in the April 1972 73, K4DHC (reprint in the July AR) uses a similar DG FET as mixer feeding an LM373 multipurpose IC i.f. etc. but unaccountably he prefers a nasty JFET as r.f. stage. I wonder why.

Use of a MOSFET tends to take care of nonlinearity leading to annoying crossmodulation, but where are the MOSFET ICs? On the other hand it still doesn't compare to a good valve -- as discussed by G3VA in "Tech. Topics" (Rad. Comm., 7/72).

Further news about linear ICs in receiver design etc. occurred in the May 1972 "Tech. Topics" (and often generally in that Column), and in Aug 72 Radio Comm.: "Consumer Integrated Circuits in Amateur Design. In that same issue, it showed the use of the RCA CA3028IC in a Direct Conversion front-end, and the NE562 in an "Infinitely-clipped" Phase-locked SSB!

In the July 1971 Wireless World there was a circuit for an SSB receiver using ICs entirely (Ref. 34a-1, EEB, 12/71), and the Apr 72 issue of the WIA's W.A. Bulletin tells that those ICs are available through Plessey Ducon P/L (Box 2, Villawood, NSW 2163). The lot comes to \$34 including tax, but it would certainly be easier than using discretes... The Bulletin also specified an overseas supplier for a 9Mc Xtal filter for \$35, but considering Customs etc. I should think that you'd do better with a local firm, e.g. Sideband Electronics Eng. (Box 23, Springwood, NSW 2777).

((No more computer boards available, but we do have a few copies of bound EEB volumes, 1970, left -- at \$43, \$C/US4.30, etc.))

-84-  
-85-

# ADVERTISING

STOPPRESS: Sale, Butterfly Capacitors, Jackson Type C.713. 25pF 0.015" A/G 5 Wilson St, Maroubra, 2035. ....

((Screwdriver adj. New, in box, \$1.50 ea, PP. P. Vogel, 5 Wilson St, Maroubra, 2035. ....

We guarantee nothing.....

This Page: Personal = FREE (for reasonable length).

FOR SALE: COMPONENTS, mostly from breakup of an analogue computer. 10K ten turn pots with dial \$2.50; Neons, lens tip in holder, 5mA: 30c ea; High precision (0.1%) WW resistors: 1Meg, 250K, 200K, 100K, and 90.9 ohms, 25c each. Relays, P.O. type mostly 1000 ohm coil and 4-pole CO, pull in on 12V, 30c ea. PMG-type key switches with fixing screws 4-pole; up-down-centre 30c ea. Carpenter polarized relays and socket (ideal for RTTY), \$1 ea. BA-nuts and bolts: 6 & 8 BA, 8 and 1 inch; 200 piece mixture, 50c. HIGH & AUDIO FILTER: containing 3 toroids and capacitors in metal can 4x4x2 inches; f<sub>c</sub> = 1120 cps with Z<sub>0</sub> = 600 ohms (Zin low, e.g., from cathode follower), insertion loss only 2.5db; characteristics likely two-pole: -6db ±40cps, -30db ±75cps, sharp nulls at -45db then back up again: \$1.50 each (heavy). ADD EXTRA FOR POSTAGE (any excess refunded, of course). R.S. MADEVER, 5 Cameron Close, Corio, Victoria 3214.

COMPONENTS OR EQUIPMENT PROBLEMS? Advertise in HAM ADS. A years subscription plus a free 75 word ad costs only \$4.00. Subscribers also obtain a special 10c/word advertising rate. Tap the enormous American market, or just look, for your own interest: HAM ADS, P.O. Box 46-653, Los Angeles, California 90046, U.S.A.

WORLDWIDE, the radio amateur's own international newspaper -- featured in the December 1971 EEB, is now pleased to offer a special low subscription rate to our DX-friends, \$US4 per year. Send to: 2509 Donner Way, Sacramento, California 95818, U.S.A. A free sample available on request. Try it! (Or send \$43.00 to EEB for a sub. -- RLG))

EQUIPMENT AND OVERSEAS COMPONENTS AT LOW PRICES Prices are often lower overseas, and availability can be better in some cases. You lose by going through middlemen in Australia. You'll lose a lot less by going through middlemen in the USA! Import problems can be minimised; see June EEB, p. 56. Try it for parts or whole Transceivers etc. Write EEB.

HAM RADIO MAGAZINE: Owing to the usual pace of inflation this excellent magazine with the execrable title will be raising subscription prices substantially, beginning January 1st. We shall continue to maintain our usual unusually-low rate of \$48.50 for 3-yrs sub to HR, until December 25th 1972. After that date we recommend you to "WIA Magpubs" who have announced in AR that they will hold their existing rate for HR mag without change "as a service to members". Namely \$5.50/yr, \$11.50/3-yrs. This is a tribute to the good sense of the Wireless Institute of Australia and to the same policies of Jim Fisk in promoting a first-class technical magazine without a spot of politics. The Institute also handles at exemplary prices all RSGB publications, the fine Orr books, all ARRL publications, and the major magazine subscriptions of the world -- not to mention a variety of components at wholesale prices, Hamfests, fellowship, and the rest. Can you afford NOT to join the Institute? Contact them at 474 Toorak Road, Toorak, Vic. 3142.

OTHER SUBSCRIPTIONS AVAILABLE for lazy readers or who are too far from a bank to buy \$US: 73 Magazine, \$6/yr, \$14/3-y. Or and CQ Magazine for \$5 per year. Also available are CQ publications (advertised therein) for \$A. Write EEB.

## EDITORIAL (continued)

Nasty Audio Amplifier Designs (ref. p. 77 here)

In the November 1971 issue of Break-In (N.Z.), Bert Shuttleworth, ZL410 presents an elegant transceiver, the "Southland Companion", very pretty (no ICs though....). But I looked twice again at the audio circuit on p. 389; that looked familiar, it's the same nasty non-bias audio circuit (viz. Class C!) by Fairchild we pulled to pieces in 1970. ZL410 comments: "this is another well-known

now to be one of Australia's major Club publications. G-UP in VK2 recently suffered massive political hemorrhage; it has been replaced by Tuned Lines, the first issue of which featured SSTV subjects and others... I was going to describe the other things appearing in the Radio Bulletin, but if you are an experimenter you'll want to subscribe to it yourself anyhow. Membership in their Club costs \$3.50 (subsequent years \$3), and although that's a bit steep for a publication it also entitles you to discount prices on their

circuit previously described at some length, and needs little further comment. Its virtue is in its low cost... However the "transistor" type of quality is not too serious, and it may be noted that although the 2-metre set has the same effect, nobody seemed to complain. Presumably, many operators have become so used to this with small and compact equipment, that they scarcely notice it."! He was referring to the quality he presumed was caused by the loudspeaker, but it's the amplifier that does the injury. From which I may tentatively conclude that amateurs (1) are masochists, and (2) are sometimes blind to the elementaries of design. As we mentioned previously an unbiased complementary audio stage can be improved substantially by providing a bit of forward bias in the form of a resistor (4c) between the bases, or even better a resistor plus diode (44c).

That same issue of Break-In also had an important announcement, SEMICONDUCTORS CAN BE DANGEROUS. ZL3TGI describes how a diode in his receiver exploded and damaged his eye. Moral: always provide a protective cover over operating equipment, or wear safety glasses (or safety-glass spectacles). You can't be safe anywhere these days. Glasses are also useful when soldering, no joke.

Finally while I'm on horrible-subjects, another one appeared in the April 1972/73, p. 51, where J. Weir gives us a regulated power supply in which the feedback signal is firmly shorted out by a 500uF electrolytic from base of the series-transistor to common. It's the kind of thing about which we warned in our 1970 series on P/S design, and this is just to let you know that such things still happen. Beware. Look for errors.

Stephen Gunther

I'm pleased to announce that Stephen has taken on the job of Draughtsman for EEB. It's hard going sometimes as he learns, but he learns rapidly and is beginning to produce some quite professional-looking work. With his mother's artistic abilities and his father's capability for hard work Stephen should become quite a satisfactory man.

I might mention further that from Stephen's crystal set (last month's EEB) an output transformer feeding an 8-ohm loudspeaker produced astonishing volume on the local teenage "music" station, perhaps only 6db or so less than "normal". Just as well, perhaps, considering the type of programme material involved. I shudder to contemplate the result if we ran the present 100 metre wire over to the other side of our valley....

Australian Publications

The Radio Bulletin, mentioned above, certainly seems

radio equipment and components..

We were saddened to learn of the demise of Don Reid's publication, Zero-Beat recently. This was a fine beginners magazine published in Melbourne. It is being discontinued because of "lack of finances and support", a pity. So far in the past few years the Australian Experimenter and Corryra have also fallen victim to this malady. EEB next?

Only if you don't help to publicise EEB. Our formal promotional efforts just keep us where we are, because a number of subscribers don't renew, each month....

Amateur Radio Techniques. IV

Although this book (c.f.p. 69 here) hasn't been reorganised as we'd like, it's still well ahead of anything in second place. The reason I am so enthusiastic about it is the fact that it is a unique and badly-needed review of the major amateur/experimenter electronics literature worldwide. This is a valuable service indeed; far too much material is being published without considering the whole picture, and without sufficient analysis.

I won't take the space to review it here again; for those who are interested it was described here in Feb 1971, and Rod has written a review of it for a current Radio Bulletin. I'll quote only two paragraphs of his/our review:

"There is one further feature of this book: you sit down to read it as you would a novel. It grips you, and once you start reading you find it difficult to put it down again. How many Handbooks can boast of this?"

"This 4th Edition is some 50 pages longer than the 3rd. The main areas of increase are the semiconductor and aerial chapters. If you already have the 3rd edition, give it to a new amateur and buy the 4th. If you don't have either, this is a book you must not miss."

Obtain from RSGB, WIA, or bookshops (dearer).

I'm sorry if all this talk about amateur radio and its publications annoys you who prefer non-communications topics, but you'll still find those scattered through EEB, and likely more so in coming months. You may also find yourself becoming interested in Something New, and that won't harm you either. In the radio amateur publications you'll often find much material of general electronics value, and it must be recognised that in the purely-experimenter field the most progress is being made in these days in amateur radio subjects. You can appreciate this if you look at the non-amateur magazines and see them representing the same tired circuits you can find in numerous circuits books, when they are not bringing something in from Industry. There are some exceptions to this, and you find them in the pages of magazines like Electronics Australia and Wireless World, but I

## TIME (Z) FREQ CALL

## QTH &amp; QSL INFO.

## NAME

1100 3660 YJ8GH Gordon Tanna Is., New Hebrides  
 0830 7085 XE1IX Peter QTHR (vis: OK Callbook)  
 0700 14268 TU2DO John Ivory Coast.  
 0700 14157 ZB2A Ian Gibraltar  
 0700 14157 9H1BX Norman Malta/QTHR  
 0400 14268 EA6BH Teo Balearic Is., QTHR  
 0700 14187 FB8XX Maurice Kerguelen, via F2MO  
 0745 14252 4U1ITU Ted I.T.U: Hq, Geneva QTH R  
 1100 14148 VK2BGT/9 Sandy Norfolk Is, VK2 QTH.  
 0730 14187 XE1J Pepe P.O. Box 200, Colima, Mex.  
 1500 14242 TL8LI Andre Centr. African Rep., via Ethiopia.  
 1500 14242 ET3JH Monaco  
 1600 14253 3A0AF Iceland. Via DL7FT  
 1100 14176 TF5TP Thor non pirate VIETNAM, v. W1YRC  
 1030 14208 XV5AC Don 20 Obispado St., Ponce, P.Rico  
 1100 14202 KP4AST Pedrc  
 0730 14206 VK2BQQ/2 Karl Lord Howe Is, GP0BX3209, Sydney

All the above taken from the home station log, those below come from home log entries during the VK/ZL Contest both CW and phone sections, but all on 14Mega ((Megahertz=essess))

1117 VR1AA (via K3RLY) With the summer VHF DX activity  
 1119 UA1CS 1204 CR7JZ just around the bend it is hoped  
 1123 KH6IJ 1211 UH8AE that next time we can drag out  
 1130 OZ6RT 1217 OH2BO something of interest from there!  
 1133 VR1W 1332 LA1KI At present there's some surpris-  
 1149 UK3AAO 1339 EP2BQ singly good DX about, considering  
 1152 OH2BBR Ans do on.. the sunspot cycle right now.  
 1158 G21AA

Ed Note: VK3YHA and several others have mentioned Maurie Batt of Victoria who is a first-rate SWL, and has won numerous awards therefore. Maurie contacted us himself when we needed temporary replacement for Greg, and offered his services. By the time we finally got around to printing the "June" issue Greg had returned from his DXpedition! so all was well. But we thank Maurie for his offer, and his many admirers. Maybe one time, if Greg does on another Xpedition!

## EDITORIAL (continued from p. 85)

do not discern therein the real excitement over the new developments which are sweeping through amateur circles..... Now this is one man's opinion. If you have an opinion on this matter let us know. EEB is yours too.

## ETC

If you received a current issue but missed a previous one to which you were entitled, complain NOW! don't wait until the missing issue is out of print! And when you complain to us, send a few cents for stamps, AND complain to the PMG or USQPO or whatever for their miserable costly service. They lose first class mail too, the very devil....

Recently we sent out some enquiries with renewal notices asking why people don't renew. Well, I asked for it, and we got some very interesting and some very crisp answers in reply. Makes good if depressing reading. Next month. Les Yelland, EEB author, answers his critics in re the use of ICs for his circuits: "I think I've used as many IC's as anybody in recent years and I'm getting heartily sick of them. Pieces like the 9914, dual two-input gate. Small item containing four trs and assoc. resistors. Rated at 4 to 5 V, but I've had to reduce to max of 3.5 to be safe. Same with the flip/flops and decades and they are supersensitive to transients. F/C admit that their 9958 decade is prone to such interference and say that improved ones are on the way; but they've been saying tht for years"

Les has also discovered that medium frequencies sound better than squeaks & squawks of HIFI, but I've cautioned him not to divulge this well-known fact, or the Industry will collapse -- and then who would buy enough components for us to ride along on with our small custom, ummmm?

Ade Weiss, Editor of The Milliwatt (EEB Review, 9/71) has written in picturesque Yankee style that his GRPP DXCC award is still available, and he even offers a trophy for the 100 country mark; "K4OCE gets his next week. It's a beauty! About 2 feet tall with this busy statuette of Lady Victory, arms up and outstretched to show off her charms to best advantage..." She is being held by his pretty Editorial Assistant Karen, in a photograph on the cover of his excellent amateur experimenters magazine. As we said last Sept, send us \$3.50 and we'll enter your name for a sub. He is losing money on this for us, but will consider himself rewarded if you contribute something to The Milliwatt: GRPP DX news, anything: to MECKLING, South Dakota, U.S.A. Do help him pls.

## L'affaire Australienne

And finally, last week the British Home Office ruled that Australians will still be able to visit Britain on holidays even after the UK enters the Common Market in January 1973. One can stand in awe of such breadandbess; perhaps the French spoke out on our behalf?

FIG 3: Vacuum phototube Circuit.

The tube was driven by a 10-watt valve power amplifier via a step-up transformer from the voice-coil output; see fig. 2. A 600 $\Omega$  to 3.5 $\Omega$  line-speaker transformer with the 3.5 $\Omega$  winding connected to the 3.5 $\Omega$  voice coil output of the amplifier was found to be as good as any. The fluoro. was biased such that maximum negative modulation peaks almost extinguished it. The bias required was approx 50 volts at 50mA d.c. and was derived from the amplifier HT via a variable series resistance, as shown in fig. 2.

Experiments using this transmitter were generally restricted by the need for a mains supply for the transmitter (although we later obtained some genemotors and ran the equipment from a car batt.).

#### The Receiver System and Photomultiplier

Our receiver at this stage consisted of either a vacuum phototube and valve amplifier (fig. 3) or an OCP71 phototransistor and transistor amplifier. Our maximum distance covered was about 500 ft, using the transistorised receiver, the main limitation being excessive receiver hiss caused by the OCP71. The valve receiver was not used for distances exceeding 60 ft because of power supply problems.

We then modified our receiver to accept the photomultiplier. Our first attempts to use the photomultiplier detector resulted in covering a distance of over 3000 ft, without modifying the transmitter. This sixfold improvement in performance was limited only by very severe interference problems caused by an inadequately filtered 1000 V supply to the photomultiplier. It was obvious, however that the photomultiplier was a much more sensitive detector. The only other light sensitive device known to us which claims similar sensitivity to photomultipliers is the photoFET, but we have not used one in our experiments.\*

The decision to use a photomultiplier detector imposed further limitations on our transmitter light source. As the type 931A photomultiplier has maximum sensitivity at 4000Angstroms, we were com-

mitted to using light sources which emitted efficiently in the blue to near ultra-violet range; incandescent lights were, therefore, useless. This is the reason we chose to use blue to near UV light rather than infrared as have all other current experiments we know of.

#### A Redesign

Our next step involved complete redesign of the system. This arose from a desire to improve upon the fluorescent tube light source used up to this stage. The main disadvantages of the fluorescent are:-

- 1) Difficulty in making the transmitter portable because of the need for high audio power drive and high bias voltage for the fluoro.
- 2) Very hard to drive, as it is essentially a constant voltage device. Modulation percentages were low.
- 3) Poor approximation to a point light source, and hence reflectors were very inefficient.

The new light source chosen was a 24 V mercury vapour lamp of approximately 5-watts output. The arc of this lamp is a sphere of less than 3/8" diameter, and lends itself to the use of more efficient reflectors than could be used with the fluoro. Because it operated on 24 V it was convenient for portable equipment.

#### Pulse-width Modulation

We also decided to change from ordinary intensity modulation, where light intensity is proportional to the modulating voltage, to pulse modulation. The following advantages were envisioned:-

- 1) Very simple drive circuits using relatively low power transistors in switching mode circuits.
- 2) High modulation percentage, as the light did not have to be biased to extinction.
- 3) Driving circuitry need not employ accurate matching to the load impedance of the light.
- 4) Possibility of using digital techniques in the receiver to achieve high signal to noise ratio. A weak signal could be reformed before being detected and hence interference would be reduced considerably, if not eliminated.

The modulation method chosen was thus pulse-width modulation, as it required the lowest bandwidth of the pulse systems (excepting pulse amplitude modulation -- but this was no improvement over ordinary intensity modulation), and would be easiest to decode.

---

\*The photoFET has a higher dark current, and probably more noise. It has high amplification, but the PMT can work at a much lower signal level. For interested parties, Siliconix makes photoFETs P-102 and P-236 through 238, available from Jacoby Mitchell Co. in Sydney (tell them we sent you). -- Ed.

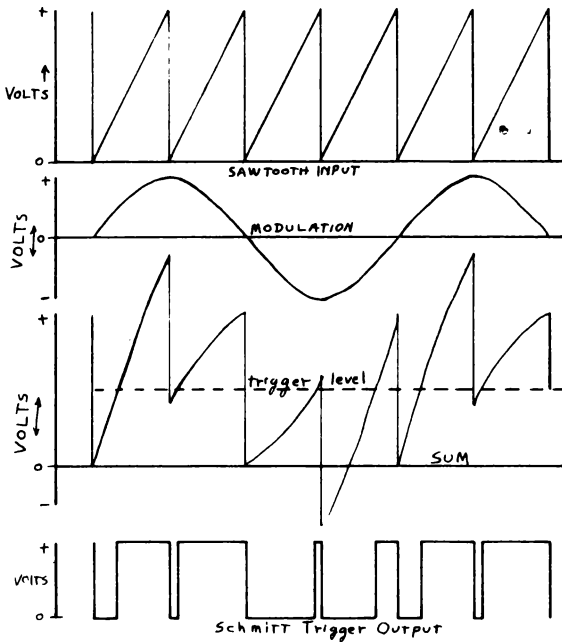


FIG 4: Pulse-width Modulation Waveforms

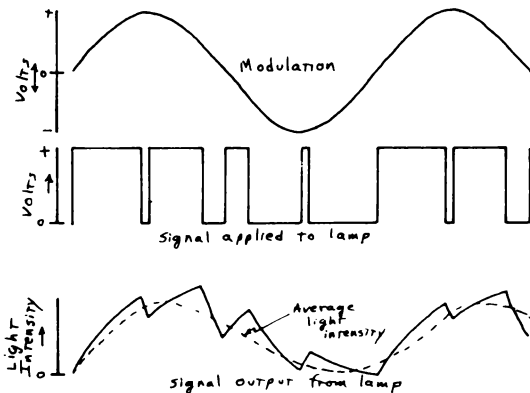


FIG5 Light Output Waveforms.

For our system, when no modulation is applied the lamp is driven by a 10kHz square wave. When modulation is present the pulse duration during each cycle is dependent upon the modulation voltage present; see fig. 4

Increasing positive voltages result in larger on-times of the light, while increasing negative voltages result in shorter on-times.

The receiver was redesigned to accommodate the change in modulation mode, and a new d.c./d.c. converter to power the photomultiplier was built, incorporating adequate filtering to eliminate converter whistle from the receiver.

A substantial amount of work was involved in these modifications which took nearly a year, but experiments with this system proved that the effort was justified by the considerable increase in distance covered, this being 3.5 miles, with a signal report of 5 by 8 (viz, perfectly readable, and quite strong at that distance)).

#### Generation of the Modulated Pulse

As mentioned previously, this technique involves the variation of pulse duration according to the modulating voltage at some particular instant. This can be done easily by mixing a sawtooth waveform with the modulation, and then using a Schmitt trigger to generate the output; see fig. 6. Waveforms are shown in fig. 4.

It should be noted that the sawtooth amplitude (peak to peak) should just exceed the maximum (peak to peak) amplitude of the modulation signal. The trig-

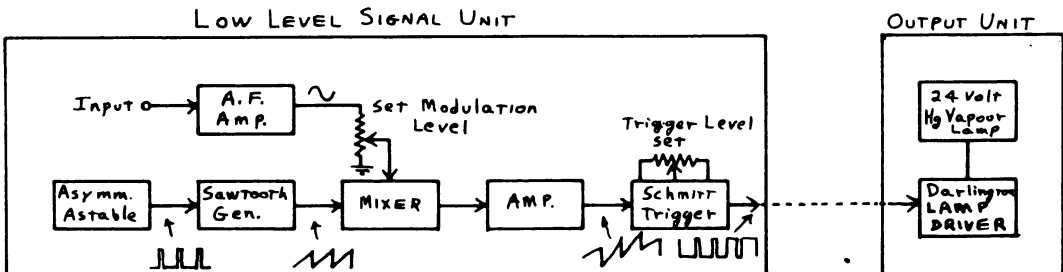


FIG. 6: Transmitter Block Diagram

ger level of the Schmitt trigger should then be set above the maximum positive (or negative -- depending on whether you use a positive or negative-going sawtooth) level of the modulation, but at less than the sum of the maximum positive (or neg.) sawtooth level and maximum negative (or pos.) modulation level. Do not ignore the signs when adding!

Under these conditions a trailing edge will occur in the pulse-modulated output each time a trailing edge occurs in the sawtooth waveform and in the absence of modulation the Schmitt trigger output will be a symmetrical square wave -- see fig. 7.

Theoretically one could use a triangular waveform rather than a sawtooth to generate the sum waveform fed to the trigger. The only difference resulting in the output would be that both the leading and trailing edges of the pulses will shift depending on the modulation voltage.

We chose to use a sawtooth, as the occurrence of a trailing edge in the pulse train output at regular intervals (depending on the sawtooth frequency) is expected to be advantageous in future decoding methods.

In common with other methods using sampling techniques to encode analogue information, the sampling frequency should be greater than twice (and preferably three times) the maximum modulation frequency. Consequently the sawtooth frequency (which determines the sampling frequency) should be a minimum of 10kHz for most speech systems.

#### Transmitter Requirements

Having chosen to use a small mercury vapour light source it was necessary to ensure that its frequency response was high enough for pulse-width modulation to be used. Tests revealed that the light output from the lamp varied approximately - 50% from the maximum peak output at 20kHz, reducing to - 1% at 50kHz; fig. 5.

It was decided to use a sawtooth frequency of 10kHz which would enable us to modulate with audio frequencies up to a theoretical maximum of 5kHz. Calculations show that for a modulation percentage of 50%, the minimum frequency transmitted is 6.7kHz and the maximum is 20kHz.

\* I.e., the difference between the minimum and maximum-on times of the output pulse is 50% of the duration of one cycle of the sawtooth waveform. -- KB

To transmit a square pulse of 20kHz, the frequency response of the transmitter should extend to 60 or 100kHz. Consequently the output from the light (whose frequency response is not this good) is not a good square wave. The waveform of the output from the light is shown in fig. 5.

This poor response of the lamp was useful in that all we had to do to detect the signal in the receiver was to put in a low-pass filter to remove the 10kHz components of the signal. In other respects the signal was effectively an ordinary intensity modulated light beam.

#### Transmitter Circuitry

A block diagram of the transmitter circuitry is shown in fig. 6. Although, as mentioned previously, it is not presently possible to present the circuit in detail, circuit elements can be fabricated from standard designs available in any good design or circuits book.

The transmitter was constructed in two units, one containing the low power stages, the other containing the lamp, built-in reflector and the darlington pair drive transistors. A sheet of perspex ("lucite") was attached to the front of this unit to protect the reflector when not in use, but was removed during transmission. The whole transmitter operated from two 12V car batteries.

The astable multivibrator generates a highly asymmetrical output which consists of a short-duration pulse at a repetition frequency of 10kHz; fig. 7. This is fed to a circuit where the pulse is used to trigger the discharge of a capacitor otherwise connected in a constant current charging circuit. The sawtooth obtained did not have a very fast decay time, and was not very linear, but

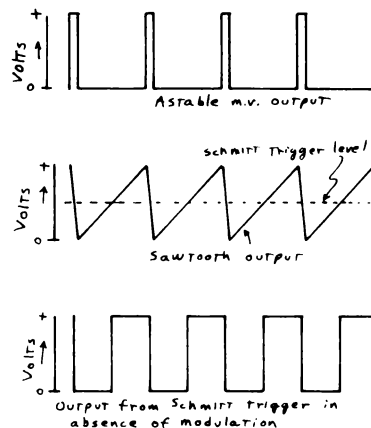


FIG 7: TRANSMITTER WAVEFORMS

neither of these characteristics are critical. Any sawtooth generator circuit could be used in place of ours.

The modulation (from a microphone) is fed into a 2-stage audio amplifier. A volume control is necessary to allow setting the modulation at the proper level for triggering. No form of dynamic compression or clipping was used, either of which would enable more efficient modulation.

The modulation and the sawtooth are fed into a mixer, the output of which is amplifier prior to being applied to the Schmitt trigger. This amplification stage should have a frequency response extending to approximately 50kHz or so.

The triggering level of the Schmitt trigger was adjustable to enable setting at the correct level. It should be set, with the aid of a CRO, to give a symmetrical square wave when no modulation is applied. The modulation level is thus set so that the previously mentioned conditions are satisfied.

The pulse-width modulated signal obtained from the Schmitt trigger is d.c. coupled to the darlington-pair output transistors. The switching transistor in series with the lamp is rated to withstand the maximum current and voltage, but because it is always either in cut-off or saturation (provided it is driven by fast rise and decay time pulses) the dissipation is minimal. A comparatively small heat sink can thus be used.

#### The Lamp

The lamp was operated according to the application notes supplied with it as far as the series resistors were concerned; I believe the lamp is made by MAZDA. A press-on, release-off switch was used in the filament circuit to warm up the lamp for starting. A bypass switch in parallel with the series transistor was used to allow d.c. operation of the lamp when the modulation was disconnected and for starting.

It was found that connecting both ends of the filament together during operation of the lamp resulted in a smaller, more uniform arc. This function was wired onto the filament switch so that when it was released the filament ends were connected together. By operating the lamp in an inverted position a brighter and more stable arc resulted. The lamp was therefore mounted in an inverted position on a fixed mounting in front of an adjustable 8" diameter polished aluminium reflector. The lamp was set at the focal point of the reflector; fig.8. The reflector was not of optical grade, and was merely spun and polished by a metal spinner with a die normally used for making frypan lids. As such it was

quite cheap (\$1.50), and a similar reflector was used in the receiver.

#### The Receiver

It was necessary to match the output impedance of the photomultiplier to the input impedance of the transistor amplifier and also to include a low pass filter to remove the 10kHz component of the signal. Aside from these considerations the receiver was an ordinary high gain audio frequency amplifier.

Considerable time was spent in developing a 12V to 1000V d.c./d.c. converter to supply the photomultiplier. The 1000V output was made free of all ripple so that it did not cause receiver interference. This was done by extensive filtering and careful layout.

The receiver was built in three sections:

- 1) The d.c./d.c. converter.
- 2) Photomultiplier and resistive divider.
- 3) Audio amplifier.

It operated from two car batteries.

The output from the photomultiplier is capacitatively couple to a BC108 impedance matching stage with an input impedance of approx 1M $\Omega$  and output impedance of approx 10K $\Omega$ . This matched the photomultiplier impedance to the transistor audio amplifier.

The audio amplifier should be of high gain and use low noise transistors for minimum background hiss. The gain in our amplifier was limited by instability. It is necessary to arrange the construction in a way such that feedback between the input and output of each stage is minimized by keeping the input circuits remote from the output circuits. Judicious use of

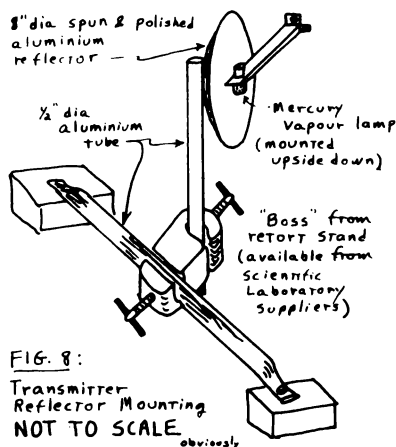


FIG. 8:

Transmitter-  
Reflector Mounting  
NOT TO SCALE  
obviously

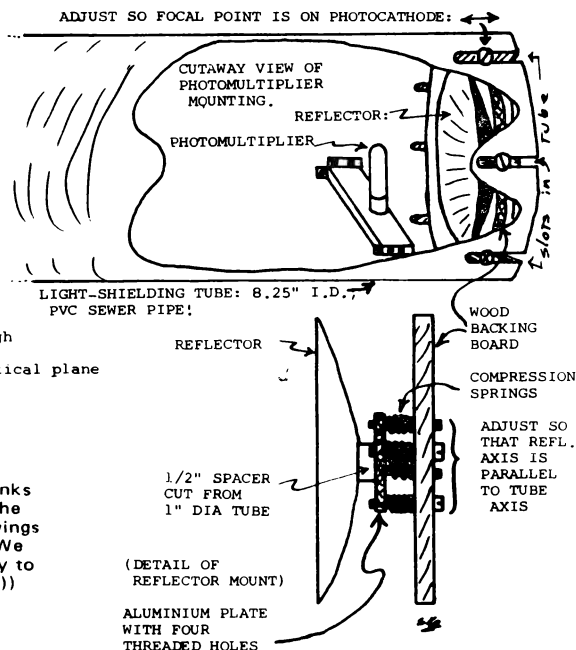
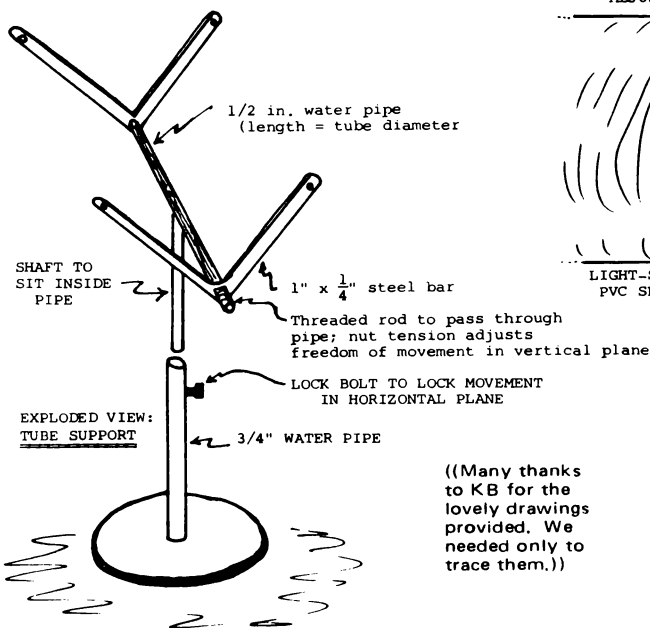
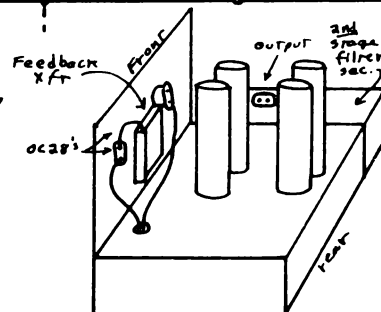
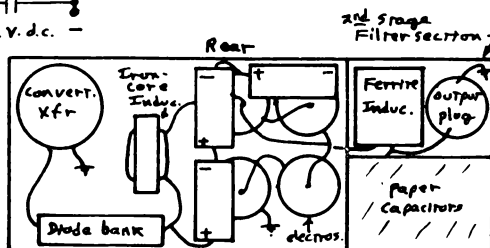
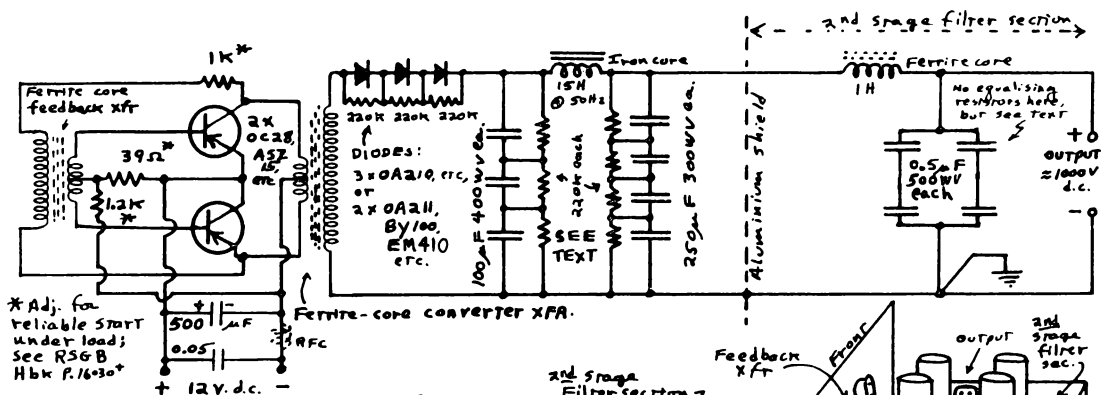


FIG. 10: RECEIVER Optical Construction

decoupling and shielding between stages will also improve amplifier stability.

Our output stage used two OC72's driving a loudspeaker, however the amplifier can be simplified by using a headphone if desired.

A low-pass filter with an attenuation of 6db per octave above 3kc was inserted in a medium level signal line (after the low level input stages) to remove components of the 10kHz sawtooth waveform from the signal. This filter used a small ferrite core inductor available from disposals sources ((lots of ferrite and much else is also available through the Wireless Institute, to members.--Ed.))

#### The D.C.-D.C. Converter (for photomultiplier)

The major effort in receiver construction was expended on building a ripple free d.c./d.c. converter to operate the photomultiplier. This gave an output of approx. 950V at approx. 5 mA for an input of 12V.

For our experimental work it was not considered satisfactory merely to operate the d.c./d.c. converter at a frequency outside the passband of our receiver. The final design is shown in fig. 9.

Both of the transformers used in this unit were home-wound on disposals type ferrite cores. The judicious filtering employed enabled us to reduce the ripple level below the hiss level of the audio amplifier, and no converter whistle can be heard in the speaker during operation, even with the photomultiplier completely shielded from all light.

Although the complete converter was built on one chassis 6" wide, 14" long and 2" deep, all the components of the second stage filtering are in a separate shielded enclosure (Shielded only by aluminium. Magnetic shielding was not necessary as the oscillator transformers and the second stage inductor were at opposite ends of the chassis.).

The high value electrolytics were made up by arranging low-voltage units in series. If this done with can-type electrolytics, remember that the cans of some of the capacitors may be at a high voltage, and should be very well insulated both from the chassis and from stray fingers.

Matched 220K $\Omega$  resistors are placed in parallel with the capacitors to equalize the potentials across the capacitors of each series string. If this is not done the total voltage will not divide evenly between all the capacitors unless they all have the same leakage currents (which is unlikely). The presence of an excessively leaky capacitor in the string may then cause the voltage across other

capacitors to exceed their ratings. It is advisable to check the capacitors before use.

Equalizing resistors are also required across the diodes, or at least the older (non-avalanche) type which we used, for similar reasons.

The filter capacitors used in the second stage filter were high quality paper types and hence no equalizing resistors were required.

It is important to ensure that the output from any one section is not near its input, as ripple may be induced in the output wiring. The output plug from the unit should be remote from and shielded from the oscillator section.

#### RAJR NOTE:

I question certain aspects of Mr. Burlinson's d.c. converter design. For one thing, it would be desirable to use 1000WV capacitors available in these days either new for not-impossible prices, or oil-filled from disposals sources. This would reduce the nuisance of series-parallel connection, and above-all, of equalising resistors. The latter can draw quite a lot of power at 1000V, and that is power taken from the input battery.

Furthermore, if the oscillator frequency is low, the 15H iron core choke is pointless, since its reactance will be negligible compared to the load resistance. If, on the other hand, the oscillator frequency is high (as appears to be the case here) the many microfarads in the first section filter appears to be far more than necessary for effective filtering. Conventional designs use only a few  $\mu$ F for photomultiplier supply filtering, and for extra capability 10 $\mu$ F should be ample. That this order of capacitance can be achieved easily (e.g. two 5 $\mu$ F ones either side of the choke -- if indeed the latter does any good), and makes the non-equalised capacitor system more practical, as mentioned above. The ferrite core inductor probably is a quite good idea, because of the large amount of r.f. hash these supplies can generate.

We have added to the 12V line two capacitors, for r.f. and transient filtering purposes, and an R. F. Choke as well (if any other equipment is to operate from the same battery), wound with a number of turns of No. 12 enamelled wire. The 500  $\mu$ F electrolytic will probably ensure against transients, but if difficulty is encountered (e.g. shorted transistors!) it could be worth considering the use of protective zener diodes as described in the various radio handbooks. RLK sug-

gested a 0.0005 $\mu$ F across the EHT winding, the design suggested (cautiously) in Stoner's Transistor Radio Handbook (E/E), but this is of doubtful utility; although it would tend to protect against transients, it would reduce oscillator switching efficiency. Now back to Burlington:

### The Photomultiplier and Optics

The converter was connected to the photomultiplier by a 10-ft length of heavily insulated wire. In use the converter was placed as far from the receiver box as possible, generally on the other side of the car. A separate battery was used to supply the converter. It should not be supplied from the car's battery lest the car body radiate converter whistle!

The photomultiplier was mounted at the focal point of an 8" spherical reflector fixed at the end of a 4-ft long 8-1/4" internal-diameter PVC pipe, which served to reduce the amount of stray light reaching the photomultiplier; see fig. 10.

The photomultiplier was fixed to the pipe and the reflector made adjustable so that the focal point could be shifted onto the photocathode. The whole pipe was mounted in a frame which allowed aiming of the unit at the transmitter. Lock-screws were incorporated to hold the unit steady after it has been correctly aimed. Ordinary shielded wire connected the photomultiplier to the receiver.

A 1000V isolation capacitor was put in the photomultiplier in lieu of very high quality coaxial cable; most shielded cables won't like having 1000V between their conductors. The circuit of the photomultiplier wiring is shown in fig. 11

### Receiver Layout

The receiver was constructed on matrix board and completely enclosed inside a 6" x 6" x 12" aluminium box. The speaker should be placed in a separate enclosure to minimise instability. The box should be connected to the ground rail of the amplifier. During use the box should also be earthed to a metal stake. If this is not done, whistle from the d.c. converter will be a problem.

Earthing the box is conveniently done by connecting it to a one-to two-foot length of 3/8" steel rod (as used for concrete reinforcement) which is hammered into the ground. This may be watered often, to improve the earthing ((and even better with some rock salt? -- Ed.))

### WARNING

According to the PMG Radio Branch, operation of this and other modulated light systems constitutes a breach of the Wireless Telegraphy Act unless the equipment and operators are licensed.

We found that the Adelaide branch were willing to grant us an experimental licence on condition that they were allowed to inspect the equipment to make sure it would cause no interference with other radio transmissions.

(Ed Note: In February 1970 (p. 50) we pointed out that our enquiry into the Wireless Telegraphy Act shows that the PMG has an Absolute Monopoly on any electromagnetic energy communication whatsoever, and that the provisions of the Act are sufficiently vague to provide control over all communications whatsoever. This obviously includes torch lights and crystal sets, and appears to include loud-hailers, car headlamps, and shouted instructions when these messages pass across common boundaries, and certainly when they cause interference with other (licensed?) modes of communication.))

### Operation

In operation we found that incandescent street lights caused negligible interference (to us), but that all varieties of gas-filled lamps (fluorescent = mercury), Xenon, Sodium, Mercury Vapour, etc -- caused very serious interference. For these experiments we therefore located a barren stretch of country road about 30 miles from Adel.

We found that we could not aim the receiver towards Adelaide, even though the city was obscured by hills, as the haze and smog over the city scattered enough artificial light to cause serious interference\*. (overleaf footnote)

In view of the Editor's comment above, it seems reasonable that we ought to have considered reporting the Electricity Trust of S.A. for breach of the Wireless Telegraphy Act by operating unlicensed street lights, modulated with a 100 Hz subcarrier, and without announcing the callsigns of the equipment originating the carriers at the regular intervals required by the PMG.

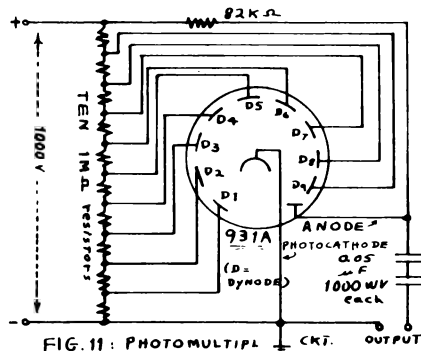


FIG. 11: PHOTOMULTIPLIER

Our equipment was designed to be portable so that we could operate in areas of no interference. Both the transmitter and receiver operated from a multitude of car batteries. We also carried a transistorised CRO with us, for testing in the field, which operated on 2 more car batteries ((viz, a battery-operated field. Hi. --Ed.))

After the author obtained his AOLCP we converted some ex-taxi transceivers to the 144Mc amateur band for 2-way communication during our experiments. These also ran on car batteries; it will be remembered that we only set up one way communication using modulated light.

Along with various lighting arrangements and 6V car batteries for the soldering irons, we carried a total of 13 car batteries -- hence the need for 2 cars! -- although this could be reduced to 3 or 4 if necessary. We did not use either of the cars' batteries lest we accidentally flattened them. The car batteries were all obtained from a friendly local garage, where we purchased his trade-in batteries at scrap value of approx. \$2 each. Most batteries were found to be satisfactory for our fairly light loads. Some, indeed, were better than the batteries in our own cars -- and we soon remedied that! At the completion of our experiments we sold the batteries to a scrap merchant. As the value of scrap batteries had risen in this period we actually made a profit.

Our experiments were generally conducted along straight stretches of road late at night (often until 4AM). Setting up the transmitter was fairly simple and took about 10 minutes. Setting up the receiver generally took 15-20 min. (including tea break and watering the earth connection). The 2-way radio link was an invaluable aid, especially over the longer distances.

Our normal procedure was to commence with the receiver and transmitter about

\* Ed. Note: I can't imagine a better place to insert the following filler:

#### Quotes without comment

"Adelaide yesterday became the first city in Australia to issue an air pollution potential alert, covering the metropolitan area" (7/7/71)

"In Los Angeles they have started to abolish classes in Physical Education, because the air is becoming too dangerous for children to breathe deeply. Yet adults there will tell you that 'its good to see the stuff you breathe' and that yellow should be the normal colour of air in a 'Great' city." -- Paul Ehrlich, ABC Radio, 1971.

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

1/2 mile apart and then move the receiver at intervals down the road if the equipment worked satisfactorily.

The transmitter was aimed by having the receiver operator issue instructions over the radio link to the transmitter operator while observing the light intensity by eye.

NB: IT IS ADVISABLE TO WEAR DARK GLASSES (GLASS, not plastic) WHEN LOOKING AT UV LIGHT SOURCES ! ! ! !

The receiver was aimed merely by adjusting for maximum audible receiver volume. Considering the low optical quality of the reflectors used, no greater aiming accuracy was considered necessary.

#### Special Notes

1) The photomultiplier should never be aimed at bright lights, the sun or moon, as saturation will occur. Repeated saturation of the photomultiplier will cause deterioration of its performance. When not in use, place the photomultiplier in a light-tight container.

2) For transmission distances < 1/2 mile or so it is generally necessary to off-aim the receiver so that the transmitter does not drive the photomultiplier into saturation.

3) We found it necessary to operate only at night time because of our crude optical equipment, as daylight caused the photomultiplier to saturate.

4) It is also necessary to keep well away from all but incandescent street lights.

5) Operate on moonless or overcast nights only. For some strange reason moonlight causes severe hiss. Even on moonless nights there is a considerable amount of hiss from the sky. This hiss level was several times the hiss level of our receiver.

Determination of the receiver noise was made by covering the light entrance of the photomultiplier pipe assembly, while all systems were turned on and operating at normal listening level.

6) Beware of haze and smog in the transmission path. They will reduce considerably the maximum transmission distance.

7) Put helper springs in your car when you carry your 13 car batteries, or else rent a truck!!

=====

Ed. Note: There's another page of "Future Possibilities"; look for it next month.

=====

A SECOND OPINION: The 1972 ARRL Handbook

-- by Rod A. Reynolds (RLG Translation)

My general impression of the book is similar to that of RLG as described last month. There seems now to be a sensible reorganisation of the whole presentation. Although some of this may well be the final impact of cumulative changes I feel that there has been a qualitative change from the practice of years past.

For one thing, the advertising section at the rear of the book has gone completely! It has been replaced by more pages of text. My initial comment about the 1971 volume (EEB Apr 1971) does indeed apply to the 1972 one, whatever my later reservations may have been about the 1971: ARRL have expanded theory and reduced superfluous matter. And, much to their credit they have reduced greatly the duplication of superfluous high power transmitters; these were replaced by some good transistorised material.

The order of chapters has been changed about, and transmitters and P/S come early rather than later in the book. I'm not sure that this is an improvement for the Tx, but it certainly is for the P/S. Semiconductors have, for the most part, been incorporated throughout the text, and the section "Semiconductor Devices contains some updating, e.g. ICs.

Needless to say, some improvements are possible. One could mourn the demise of the section "Testing Unknown Rectifiers" which appeared in some earlier editions; there is still a large number of disposals diodes which merit such testing!

It is a pity that there is no "Integrated Circuits" section in their "Semiconductor Characteristics" chapter; the material presented in the text is not nearly adequate in this regard. For amateurs who (like us) do not necessarily have specific ICs at hand, or for others who might wish to make substitutions, it would be most desirable to know which pins served what function.

On p. 520 there is an oscilloscope circuit for monitoring modulation. For the Tube they specify: "V1 - Electrostatic-deflection cathode-ray tube, 2- to 5-inch. Base connections and heater ratings vary with type chosen." But there isn't a single CRO tube listed, either base diagrams or characteristics in the "Vacuum Tubes and Semiconductors" characteristics chapter. It is well worth keeping older editions of the Handbook.

Finally, one must note the quality of the paper which has deteriorated steadily for several years, and which is now an aged newsprint yellow. Surely it would be possible to improve this paper whiteness a bit -- and charge another 50c? But the non-glare (matte) finish should be retained; it is most worthwhile.

Overall, ARRL are obviously making considered progress with this 49th Edition, and we have every hope that they will produce a really first class Handbook for their anniversary 50th one, when the remaining redundancies will have been eliminated, and their crisp prose will be presented on reasonably clean-looking paper.

=====

WHERE ANGLES TREAD: a squaretable, of sorts.....

PART I:

The ARRL Handbook; A Rebuttal, by D. A. Blakeslee, W1KLK. EEB, Feb 1972, p. 19.

PART II:

RLG to DAB, 28 Feb 1972:

Dear Sir,

Your comments of February 14th regarding our review of the 1971 edition of the ARRL Handbook are noted, and are being referred to the Reviewer for comment and publication.

I may, however, note that your comment in respect to the review of the Radio Handbook by Orr was uncalled for, and I do not intend to print it in the form submitted. That book was examined in meticulous detail by a communication engineer and by a radiophysicist -- both radio amateurs closely concerned by the future of amateur radio technology -- and every effort was made to provide constructive comment which might be of value in maintaining the standard of that fine Handbook.

These matters have been communicated in some detail to the Author, only a small portion of which appeared in our review.

Our Solicitors advise us that most of the last paragraph in your letter, involving your opinions of 73 Magazine, are libellous, and that we are not at liberty to print them.

Yours faithfully, etc.

PART III:

"Objects and Requirements of an Amateur Radio Handbook, Part II", by R. A. J. Reynolds, VK7ZAR, EEB, Feb 1972, p. 20.

PART IV:

"The 1972 Radio Amateur's Handbook" (Published by ARRL, Newington, Connecticut, U.S.A.) -- being essentially a Review of that work by D. A. Blakeslee, W1KLK, which was included in the same Post as the item in Part I, above. EEB, Apr 1972, p. 41.

PART V:

DAB to RLG, 28 March 1972:

Dear Mr. Gunther:

Quite frankly I didn't expect any of my letter would appear in EEB. I find it interesting that you will allow your reviewer to comment on my letter. I understand from private correspondence from Mr. Orr that he wrote to you before the review of his book appeared, but I didn't see any of his comments in EEB along with the review. Apparently reviewers have privileges not accorded to authors in your publication.

My letter was a comment on the way that EEB does its book reviews, and thus I feel my views on the review of the Radio Handbook were quite germane to the subject at hand. I don't doubt the qualifications of the gentlemen who did the Radio Handbook piece. In fact, their professions were quite visible via their words. But, I also have a background as a communications engineer, having designed systems in England, Germany and North Africa. Later I worked as Vice President and Director of Engineering for a five-company group that manufactured telephone and audio equipment. The Australian government recognized the value of our designs and favored us with a number of orders. Now I have given up commercial enterprises and am devoting my life to amateur radio. I frankly cannot understand why your reviewer's opinions should rate the better part of an issue, but a paragraph from me is labelled "uncalled for" by you.

I fear your reviewers have lost sight of the purpose of a review. This weekend I am writing a book review for publication in Spectrum, the

journal of the Institute of Electrical and Electronic Engineers. I have examined the book for several weeks trying to analyze the purpose the author had in mind, how well he covered his subject, and of what value the book might be to a reader of Spectrum. I have no doubt that if I went off on a flight of fancy about how I would write such a book that the IEEE editor would place my review in the dust bin, and rightly so.

If one wants to write an article on what a handbook should contain, fine. But it should appear as an article, not as a book review. I get some 1000 letters of comment per year about the ARRL Handbook, most of which are very useful. You may think that your Radio Handbook review was constructive, but as a working author I can tell you that most of the comments were so vague as to be of little value. What has happened is that your readers still do not know very much about the new edition of RH.

Ah, I appreciate the concern of your solicitors. Guessing that your laws on libel probably follow the English, rather than those of this country, it would appear that by publishing a review which the author has retracted in public as being untrue, EEB has already been close to libel. I can understand your solicitor's advice not to touch the subject again, as solicitors are the most cautious of men.

Sincerely, etc.

#### PART VI:

A Comment by R. H. Ferris, VK7ZDF, author of "Objects and Requirements of an Amateur Radio Handbook, Part I -- and a brief discussion of the Radio Handbook, 18th Edition, by W. I. Orr..." :-

This trivial argument appears to arise from a conflict of fundamental goals, and a failure by Mr. Blakeslee, the ARRL Handbook's Editor, to take at face value what we have clearly stated in print: The Review of the Radio Handbook was an examination of the philosophy of handbook writing, as in fact stated in the title (as above), the leader, and the opening paragraph.

We do not draw the fine distinction between an article and a Review in EEB. For us a Review must examine not only the "purpose" and how well the author covered his subject, but whether or how the subject covered was worth covering.

Thus, the Radio Handbook by W. I. Orr was considered in its entirety with relevance to the requirements of the subject. This approach contrasts sharply with the rather pedestrian practice simply of listing a selected portion of the subject index, which can (at the whim of the Reviewer) be meaningless or misleading.

I can, indeed, be in general agreement with Mr. Blakeslee's expressed ideas about the book review for IEEE without fear of contradicting what I have stated, recognising merely that the task of making a review for IEEE is different than one of making a review for EEB. The philosophy of approach is different, the audience and their requirement is different, and thus the review cannot be provided in the same context.

#### PART VII:

A Comment by R. Leo Gunther, sometime editor of this magnificent publication:

Our Solicitor's veto of a portion of Mr. Blakeslee's Letter (Part I, above) was not based on the validity of the Review taken from 73 magazine (which was rather a favourable view of the ARRL Handbook -- which the author later retracted? -- hi!). It was based on the indisputably strong comments made by Mr. Blakeslee on the integrity and honesty of the publisher of 73 magazine. Quite

aside from our own opinions on that matter, it would be dangerous to print such material. We got into a fair bit of trouble last year on a statement which was substantially tamer than the one Mr. Blakeslee submitted to us!

As for fairness in reviewing, well, as I said we'd do (Feb EEB, p. 19), we printed Mr. Blakeslee's comments about the 1972 ARRL Handbook. I reckon we are being reasonably open-minded to allow an Editor to review his own handbook.

#### PART VII:

((Since we have afforded Mr. Blakeslee the abovementioned Privilege, it seemed only reasonable to extend same to Mr. Orr, whose reply is presented here below.))

WIO to RLG, 12 April 1972:

Dear Leo,

Thank you for the privilege of letting me review the Handbook. Well, I would start out by saying that the Radio Handbook, in its small way, compensates for the burning of the Library of Alexandria in the year 640 by Hadrian and that it fittingly plugs the cultural gap of the ages. That seems to cover things pretty well.

Yours, etc.

#### PART VIII (concluded):

Call it off, Doug! I think you've done a fine job in QST, and even the 1972 Handbook isn't so bad for a change. And lo! Rod agrees with me, so it must be true.

Cheers, *Leo*

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

#### FILTER VS PHASING EXCITERS -- Revisited

Please consider the following item to be added to the material in EEB April 1972, p. 41 -- which should now be reexamined.

A quotation from the 1972 ARRL Handbook, P. 391: "... and alignment stability. It is still practical for the builder to fabricate his own crystal-lattice filter by utilizing low-cost surplus crystals. This possibility should not be overlooked if the builder is interested in keeping the overall cost of the home-built exciter at a minimum."

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

#### WHAT NOT TO DO ?

I once made a 5V filament transformer for a chap who wanted to isolate rectifier filaments. He explained that he had one with tapings of 1.5V, 2.5V, and 6.3V. He found that by short-circuiting the 1.5V winding the 6.3V one came down beautifully to 5V. He actually used it for a while until it turned odd colours and stopped working!

-----  
HELP! We're running out of "What Not to Do ?" items. How about you good readers sending us some -- anonymously, of course. -- Ed.

HIDDEN ANTENNAS

-- a Squaretable, between K. A. Harding of Sydney, and the Editor

**KAH:** The article by Lionel Sharp in the October 1971 EEB on the "Motorola Semiconductor Data Book" will probably result in Dresser of Corinda being inundated. I did write to Motorola Sydney but got no reply. On the other hand, I wrote to Motorola informally asking for application notes, and back they came with no trouble. So you take your chances?

**RLG:** You've had better luck than we had.

**KAH:** All right, but here's an interesting problem possibly more amenable to solution:

Local regulations forbid roof-top antennas, or anything like a permanent structure in my little courtyard. So, the thing to do will be to build a relatively simple receiver and try it out on some sneakily contrived vertical antenna. There is little point in my trying to tackle a good general coverage receiver unless I can bring in the signals.

That antenna could run up the outside wall to about 20 ft high, but reading leads me to believe that the building itself will cause big losses. The only other alternative that comes to mind is a permanently fitted antenna base near the back of the courtyard (only about 12 ft from an aluminium roofed patio), and going out there to set up and/or take down the "pole" when necessary. It doesn't sound very satisfactory.

Still -- i've heard of amateur operators working out from 2nd floor flats in multi-story towers, so there must be a way -- even if efficiency is down.

**RLG:** Maybe you could try a vertical antenna on a balloon filled with helium -- or hydrogen if you don't mind explosions? Trouble with this is that if the balloon is lightweight the helium will diffuse through it, necessitating occasional replacement, and helium is expensive.

On the other hand you can pick up just about as much signal with a short antenna as with a long one, IF the short one is suitably matched to your receiver input (or transmitter output) circuit. This is not generally realised, but is the cornerstone upon which very short high-performance antenna systems are based -- just run your antenna into a source follower (into the receiver) and tune out the reactance. Aside from this, the main reason to have an antenna out in the clear is to get away from noise (or to avoid r.f. getting into the power lines, telephone, etc if transmitting)

For a suitable short or long antenna you might try the old trick of using a thin wire (e.g. No. 26); the neighbours won't likely see it, but keep it above head level! Maybe use a nearby tree as Sky Hook. Or even the eaves of the house of a cooperative neighbour??

I should like to repeat that we don't ordinarily conduct a consulting service, but this is a problem which interests me. I have dug into the Files, and came up with the following relevant references:

"Using a T-Network", W2EY/1, CQ, May 1968:  
"The Pi-network is familiar to all as a circuit used in most transmitter output stages and un-

balanced type antenna tuners. A 'T' network tuner which employs the same elements as a pi-network but in a different circuit arrangement, has definite advantages over the pi-network when a match to a very short antenna is required."

"The Apartment Dweller's Dilemma", by W1ICP, QST, Oct 1971: "How to use Random-Length Wire Antennas". "There are some exceptions to the following rules but in general, they can be depended upon.

1) An outdoor antenna will work better than an indoor one.

2) An antenna inside a frame building with wood exteriors is better than the same antenna in a steel-and-concrete building.

3) The higher above ground, inside or out, the better the antenna will work.

4) The bigger (or longer) you can make an indoor antenna, the better -- even if it means running the wire around corners.

5) Even a poor antenna should produce some contacts."

"Sky Hooks" by GM3SIY, Rad. Comm., Jan 1969: How to make your own hydrogen and fill a balloon with it; for heavens sake be careful!

"An Indoor Aerial", by G3NXM, Rad. Comm., Jan 1972: A trap dipole loaded about in the centre of each leg, and mounted in the attic.

"The Window-pane Simple Quad", "8AP, from QST Sept 1971 and reported in "Technical Topics", Rad. Comm., Jan 1972. Tape aluminium foil to a window!

"Using Thin-Wire Antennas", W2EY/1, 73, Nov 1968: Thin wires can be used, but present various problems, particularly if transmitting. Ideally it should run at right angles to the building, to reduce losses. And the resonant frequency, reactance, and directivity of a thin wire are not likely to be the same as thick. Best idea is to cut and try. "Almost any type antenna placed outdoors will work better than an indoor type...."

"How to Fly Your Kite", EI4R, 73 May 1969: The design and construction of a suitable Sky Hook; scale up a "kiddie kite", use lightweight braided wire, and run full wave on 160 M!

"Twin Bisecting Loop Antenna", W9JBM, CQ, 2/72, If you put two loops in series, bisecting each other at right angles, you can get a full-wave antenna with no single leg longer than 1/8 wavelength. See article for details.

XXXXXXXXXXXXXXXXXXXXX

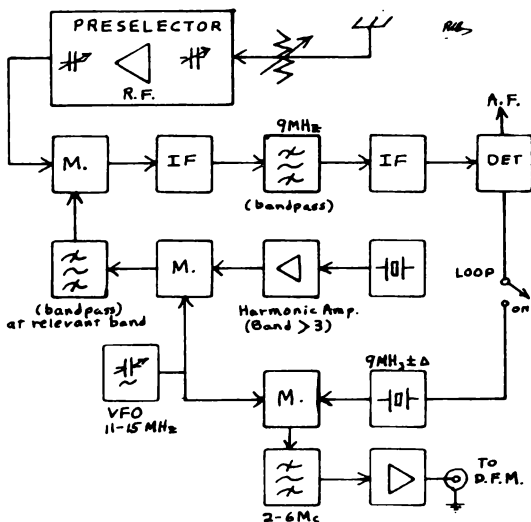
How to tell a Mouse from a Rat

If you are troubled by wee scamperings, set a mousetrap. If it is a mouse, a suitably baited mousetrap will work inevitably, and with less grief than one of the fancy modern chemicals. If the trap is overturned a couple of times without quarry and then is not disturbed, good chance it's a rat. In that event use a suitable mixture as described in EEB 1970, p. 80 or buy a proper rat-trap. If this fails there is no alternative to the use of a chemical poison, but these tend to have the disagreeable effect of allowing the creature to die in the walls, creating a fearsome stink for a while....

**LETTER: General Coverage Receiver Design**

Some time ago I mentioned about a digital counter. Well I never got round to writing an article about it, and now its out of date, that's how fast the State of the Art progresses. Nonetheless its still doing a good job and I hope to add a divide-by 20 unit to extend its range to 160kHz.

I note with great interest the discussions re cross modulation in receivers, using FETs, etc. I am in the planning stages of a general-coverage receiver, 2-20 (+) MHz, all transistor using 9 MHz Xtal filter I.F. Basically it will have 4 Mc bands if it works out as I want it, the main VFO covering 11-15MHz and then mix that with 4 MHz Xtal and its harmonics for the higher bands. This to save band-switched VFO. Maybe its a hard way to go about it, but worth a try. Thus:



((D.F.M. = Digital (or other) Frequency Meter))

**BAND MIXER VFO INJECT.**

|          |                         |
|----------|-------------------------|
| 2 - 6MHz | 11 - 15 MHz             |
| 6 - 10   | 15-19 (11 → 15 + 4 MHz) |
| 10 - 14  | 19-23 (11 → 15 + 8 MHz) |
| etc      | etc ( etc )             |

The V.F. Osc. dial to be calibrated perhaps every 50kHz or so and provision to mix VFO with 9MHz Xtal to give a 2 - 6 MHz output to feed the Digital Frequency Meter for accurate readout if required. 9MHz osc. to have  $9\text{MHz} \pm \Delta$  (3kHz) Xtals also to read SSB, this being used as BFO injection.

The biggest problem at the moment is the Band Pass Filter between VFO mixer and signal mixer. This is to keep the injection free of spurious and unwanted mixer products from 4 MHz harmonics, etc. But this shouldn't be impossible.

Now with all your talk for and against FETs, especially dual gates (e.g. 3N140 etc) I am not so sure what to use as mixer, but am in favour of a ring of diodes as we use in telephone carrier work. Anyway I intend to try this.

Another problem, does anyone know where to get hold of a LINEAR FREQUENCY LAW tuning capa-

citor? Single gang will do, for the VFO tuning. Its nice to have a linear frequency scale, but where to get such a capacitor nowadays? The old HRO Receiver had something like it, but in 4 gang. Maybe someone knows someone who makes these still!

Incidentally, crossmodulation problems are especially severe here, as most towns have HF communications with the rest of the world, and up to say ten HF transmitters on at once from 100 watts to 1kw (++) each and all in the 4-8MHz range.

Your mention of unintentional mixing outside the receiver ((due to rectification by roofing iron, plumbing, etc, and reradiation of the mixed signals to the receiver, which can thereby do nothing to separate them)) is also interesting, as this is something we run into a lot. One very common one is guy wires and fittings at the Tx or Rx aerials themselves. And often it is not just a plain mixing but the second harmonic of one Tx with the fundamental of the other. But you can't receive the 2nd harmonic! Its strange but true.

An example:- an F.S.K. Tx on 7.3MHz approx, an AM Tx on 6.8MHz say, will produce interference on 6.3MHz ( $2 \times 6.8 - 7.3\text{MHz}$ ), but you can't hear the  $2 \times 6.8\text{MHz}$  signal. Just some of the frustrations of radio communications, but most interesting.... The only real cure for us anyhow is to find and eliminate the offending "diode" external to the receiver -- sometimes a long and tiresome process.

-- C. S. Schulz, VK9ZEV, Goroka, T.P.N.G.

((This chap has some good ideas on receiver design the most important of which is actually to get around to it. However, I can see one basic problem in the system that he proposes, and that is his choice of 1st I.F. frequency. Yes, it would be nice to use one of those 9 or 10MHz Xtal filters, but stability around 9MHz would leave something to be desired. Why not use a 40MHz I.F. or at the other end of the scale an I.F. around 1 MHz, in order to get better stability. And there is a lot to be said for going a little bit further and using a 1 - 2 MHz VFO and a 1 MHz Harmonic Generator. This gets more and more like the RACAL, and most modern wide range receivers, but it is very convenient, and very little extra trouble.

((As far as the first converter injection filters are concerned, there is no easy way of getting around this. Good harmonic selection, and good injection filtering are a must. See circuits of RACAL for example, for some ideas.

((No comment on the absence of the second harmonic of that "down-pipe mixing" interference. In this game, anything can, and does happen! Best of luck! -- RAJR))

XXXXXXXXXXXXXXXXXXXX

**Ed. Note:**

Mr. Schulz's reference to unintentional mixing outside the receiver came from our article in EEB, Aug. 1969, p. 89, titled "Effortless Cross Modulation". The cure lies in bonding or tightening all loose roof surfaces, and this could be awkward if they are on your neighbour's roof. A year or two ago I also wrote a Letter to Break-In, pointing out some absurdities in the attitudes of Officialdom on this subject....

Most tuning capacitors have a certain amount of offset to improve linearity; the rest can be achieved by restricting frequency range by padding -- as described in several periodical articles.

Article on optimising Front Ends, EEB 2/73.

**LETTER: Antennas as Noise Source?**

Could it be possible that much of the noise coming into receivers could be due to galvanic action in the antenna, and not merely caused by internal noise in the valves?

For some time I have been of the opinion that much of the noise in receivers is caused by using much aluminium construction and incorrect fixing material -- e.g. steel, brass, copper, etc, since the components contained therein could be at an entirely different electrolytic potential.

-- F. W. Chapman, Ekibin, Qld.

((Only in a strong wind, perhaps, when materials rubbed together, but that would only give a "static" noise, not the kind of "shot" noise characteristic of electron movement in valves, resistors, etc. -- Asst. Ed.))

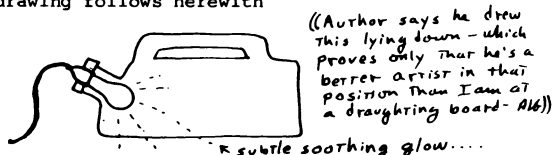
XXXXXXXXXXXXXXXXXXXXXXXXXXXX

**LETTER: Artful David**

Here's an idea which is, I think, a suitable sequel to the Super Wormturner (EEB, June 1969). It is an artistic piece which anyone can make and hang in their lounge room with pride.

**Recipe:** One coloured plastic water container, Jerry-can style (some 60c at Coles), One BC Socket, 2-core 240V flex-plug 240V light bulb.

**Method:** Cut a hole in the screw-on lid which is the right size to fit the socket through. Wire up and insert light bulb (whatever size you can get to fit through the hole). Put in a suitable place and switch on; then enjoy the adoration and envy of your friends. The drawing follows herewith



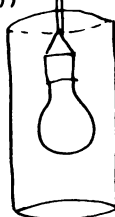
The same sort of trick can be used with many translucent coloured plastic containers. Perhaps if enough staunch socialists build these kind of things, the "art lighting" people with their schizophrenic price tags (i.e., prices entirely divorced from reality) might be driven right out of business?

On an ecological tambourine.... Electric power supply is ultimately the greatest pollution problem..... ((etc etc)).

Would you like an article on sources of power supply? ((YES!)).....

An interesting point concerning marijuana research in Australia: a psychology student wanted sponsorship to do toxicity research on marijuana. He was advised by the Honourable Customs Minister to approach the breweries, which he did, and they sponsored his research. Considering.... ((I think we won't carry David's discussion much further here. Don't want to tweak the Lion's Tail too hard at a time...))

Do you want an article on marihuana too? ((NO!))



Before I go, here is another rather effective light source, shown at the left. You have lots of ways of attaching the lamp; think up one yourself. The shade is a piece of Cirenoid coloured filter rolled into a cylinder. This gives a diffused coloured light from the sides, and a strong white light downwards, increased by reflection from the inside of the cylinder...

Now these two ideas are original, with a friend and me, and are NOT TO BE MADE FOR SALE BY YOU (but ok by me). If you give them away that's OK, but no rake-offs please!

(Put that bit in if you ever publish them)

-- D. Brown, Gosford, N.S.W.

((I don't think it will drive the "art lighting" people out of business. I've noticed that when the YF wants a nice light fixture there is talk about how easy it is to make a nice one, but eventually the retailers furnish the merchandise, at a healthy price. -- RLG))

XXXXXXXXXXXXXXXXXXXXXXXXXXXX

THE AUSTRALIAN EEB: Editor = R. Leo Gunther (VK7RG), Asst. Ed. = Rod A.J. Reynolds (VK7ZAR), Assoc. Ed. = Chris Pitcher (Northcote, Vic.), Associates: L. J. Yelland (Pahran, Vic.), R.S. Maddever (Corio, Vic.), Draughtsman = Stephen K. Gunther. Subs Managers = R.A. Walton, F. Merritt, or N.Z.A.R.T. Brenda Ford is Secretary, and ensures publication of EEB notwithstanding.

**SUBSCRIPTIONS:**

**Aust. TPNG:** \$1.55/yr, \$4.20/3-yrs; sent to R.A. Walton 115 Wilmot St., Huonville, Tasmania 7005.

**New Zealand:** \$1.55/yr, \$4.20/3-yrs; sent to N.Z.A.R.T. P.O. Box 1459, Christchurch (in N.Z. funds).

**Canada, USA:** \$2.80/yr, \$7.40/3-yrs; sent to Frank Merritt (VE7AFJ), P.O. Box 309, Parksville, B.C., Canada. (Send cheque or Money Order in your own currency)

**Elsewhere:** \$1.15/yr, \$3.15/3-yrs to Walton.

**BOUND VOLUMES:** 1971 = \$A2.55, \$NZ3.00, \$C3.80, etc., pp. All previous volumes are now out of print, sorry.

**Back Issues:** 30c each, post free; 1972 only.

**SUBSCRIPTIONS** begin only with the next regular issue; all others must be ordered separately as back issues. EEB is usually late, and it also takes time to process back orders, so please be patient (for a while).

**RENEWALS:** If you can stand more EEBs please send your renewal promptly when you receive your Notice, but **NOT BEFORE**; if you send too soon it mucks up our primitive paperwork system; if you send too late, ditto. If you don't renew at all, the Editor feels rejected and sad.

**COMMERCIAL ADVERTISING:** \$10/page, \$6/half-page, not too bad for a circulation approaching a thousand enthusiasts. Personal adverts of reasonable length are free on the blotter pages in the centre of each issue.

PLEASE PLEASE **PRINT** YOUR NAME AND ADDRESS **CLEARLY** on any correspondence to us. Pretty please? Thanku.

THIS ELECTRONICS EXPERIMENTERS BULLETIN IS PRINTED AS A LABOUR OF LOVE EVERY OTHER MONTH or so, BEGINNING FEBRUARY or so. PROSPECTIVE AUTHORS SHOULD SEND FOR OUR "MANUSCRIPT POLICY" SHEET. ARTICLES EARN FREE SUBSCRIPTION CREDIT (only). IF YOU HAVE A TECHNICAL FACT OR OPINION, OR RECIPE, HERE IS YOUR OPPORTUNITY TO SHARE IT WITH OTHERS.

The Offset portion of this odd publication is printed as a labour of love (considering their reasonable charges) by the Advance Publicity Co., Hobart 341-817.